JOURNAL
of
FARM ECONOMICS

AFEA Winter Meeting In New York
December 27-29, 1955

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THE AMERICAN FARM ECONOMIC ASSOCIATION
Volume XXXVII AUGUST, 1955 Number 3

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Price: $5 per year, this issue $1.25

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P. L. & R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscription $5. Published at Menasha, Wisconsin.

JOURNAL
OF
FARM ECONOMICS

Volume XXXVII AUGUST, 1955 Number 3

CHANGES IN THE STRUCTURE OF DEMAND FOR FARM PRODUCTS*

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STATISTICAL demand analyses are widely used in connection with agricultural outlook work and with the appraisal of economic policies. Most of these analyses are still based on data for the years prior to World War II. Although there are good reasons for this, economists and policy officials naturally feel some concern as to the continued applicability of prewar relationships after more than a decade of economic change.

The main purpose of this paper is to appraise the various factors that may have caused changes in the structure of demand for farm products since the prewar period. As a prelude to this appraisal, some observations concerning the quality of the prewar demand analyses themselves may be in order.

I. *Measurements of the Demand for Farm Products Prior to World War II*

Statistical demand analysis is now in generally good repute among agricultural economists. This has not always been so. It enjoyed wide acceptance during the 1920's. But it received a number of serious blows along the way, each of which helped to convince skeptics that statistical demand analysis was at best an art and at worst an illusion. In 1914, Henry L. Moore lifted the eyebrows of his colleagues with an upward-sloping "demand curve" for pig iron. In the mid-1920's some analysts turned out near-perfect correlations that went wide of the mark on their first *bona fide* forecasts. In 1927 Elmer Working formulated what is now called the identification problem, that is, the problem of separating demand curves from supply curves. In the same year, Yule raised the sug-

* Paper presented at the annual meeting of the New England Research Council, April 26, 1955.

** The author assumes full personal responsibility for the views expressed in this paper.

gestive question, "Why do we sometimes get nonsense correlations among time series?" Frisch also became concerned over the effects of high intercorrelation among time series and said (1934) that "A substantial part of the regression and correlation analyses which have been made on economic data in recent years is nonsense for this very reason." In the mid-1930's some of the more sophisticated demand analysts became worried about serial correlation.

Each of these shocks strengthened the conviction of many economists that they had been wise not to waste their energies on statistics. But, for the most part, the men who had raised the troublesome questions about demand analysis were not discouraged themselves. Moore's demand analyses for farm products (as distinct from pig iron) gave correct signs and reasonable coefficients. In 1926 some economists in the Department of Agriculture forecast a decline in the price of cotton so accurately that Congress forbade them ever to do it again. Fears of the identification problem were partly dispelled by Ezekiel in 1928.[1] Frisch developed an elaborate technique for screening out (a large proportion of) nonsense correlations. Koopmans and others brought the serial correlation problem into perspective, and Haavelmo made a brilliant generalization of the identification problem, opening up ways for separating a demand curve from a supply curve even if shifts in the two schedules were simultaneous and correlated.[2]

Other developments, some of them made during or after World War II, have also contributed to the quality of the existing body of demand analyses based on prewar observations. Data on national income and food consumption have been greatly expanded and improved. The expansion and refinement of statistical data have encouraged a more explicit use of economic theory in setting up analyses. The pure theory of consumer demand offered little help to price analysts when the only statistics available related to prices and production at the farm level. This theory assumes great practical importance, however, now that we have estimates of final consumption, retail prices, and disposable personal income.

In brief, the past decade has witnessed great progress in the field of statistical demand analysis. The prewar data for many farm and food products have been analyzed in a competent manner. If agreement on economic theory, convergence in statistical methodology, and similarity of results obtained by independent investigators are criteria, it is fair

[1] Ezekiel argued that "correlated shifts in demand and supply schedules, which Working feared might completely invalidate many price-analysis studies, are not so likely to cause trouble as he thought." Only the instanteous adjustments of supply to price within a given time unit could give rise to such trouble, and these adjustments (for farm products) were generally small relative to those in subsequent time periods.

[2] See footnote 1.

to say that statistical demand analysis is approaching the status of a science. It cannot, of course, be an exact science. The range of statistical uncertainty in its findings may always leave some latitude for choosing different hypotheses or functional forms. But it is not an illusion; and although some analysts are more percipient or more energetic than others, I would not label these differences as "art."

If it is accepted that the prewar structures of demand for some major farm products have been measured with reasonable accuracy, there are at least three possible approaches to the investigation of changes that may have occurred in these structures from (say) 1940 to the present time. The first of these is to consider one by one the various factors that might be expected to change demand structures and to make at least rough estimates of their potential effects. The second is to take statistical demand analyses that have been fitted to 1922-41 data and to compare estimates based upon them with actual postwar observations. The third is to estimate new demand functions exclusively from postwar observations and compare them with analyses based on prewar data.

These three approaches will be taken up in turn.

II. *Factors Causing Changes in the Structure of Demand*

Most of the prewar demand analyses based on time series are in terms of national average levels of price, consumption and income. No explicit allowance is made for changes in the distributions of economic variables included in the analyses or for social and demographic factors that also might condition the national average results. The demographic factors will be treated first.

A. *Changes in Demographic Factors*

Since 1940 we have witnessed a tremendous upsurge in population. High birth rates have changed the population age distribution, and there have been major geographic shifts. The percentage of the population living on farms has declined sharply. The high marriage and birth rates of recent years have doubtless affected the distribution of families according to size. Though these phenomena are highly important for other sectors of the economy, such as housing, we are interested here only in their relevance to possible changes in the demand for farm products.

1. *Age Distribution.* Distributions of the total United States population by age groups as of 1940 and 1953 are shown in table 1. The 1953 population contains a substantially larger percentage of children under 10 and adults over 55. Conversely, it contains a smaller percentage of children aged 10 to 19 and young adults aged 20 to 34. The percentage of adults aged 35 to 54 is about the same.

TABLE 1. AGE DISTRIBUTION OF THE TOTAL POPULATION AND ITS EFFECTS ON RECOMMENDED DAILY FOOD ALLOWANCES, UNITED STATES, 1940 AND 1953

Age group	(1)	(2)	(3)	(4)	(5)	(6)
	Population distribution				Recommended daily dietary allowances	
	Actual		Percent of total			
	July 1 1940	July 1 1953	July 1 1940	July 1 1953	Calories[2]	Protein[2]
	Millions	*Millions*	*Percent*	*Percent*	*Number*	*Grams*
All ages	132.8[1]	160.4[1]	100.0	100.0	—	—
0–4	11.4[1]	18.2[1]	8.6	11.3	1,000	40
5–9	10.6	15.6	8.0	9.7	1,800	55
10–14	11.7	12.4	8.8	7.7	2,600	75
15–19	12.3	10.8	9.3	6.7	3,000	85
20–34	33.0	35.4	24.8	22.1	2,800	60
35–54	34.0	40.6	25.6	25.4	2,500	60
55 and over	19.8	27.4	14.9	17.1	2,200	60
Weighted averages:						
(a) Based on 1940 age distribution:					2,400	61.52
(b) Based on 1953 age distribution:					2,319	60.08

[1] Adjusted for underenumeration of young children. Based on U. S. Census Bureau *Current Population Reports*, Series P-25, Numbers 93 and 98.

[2] Based on *Recommended Dietary Allowances*, National Academy of Sciences, National Research Council Publication 302, 1953, p. 22. Allowances have been roughly adjusted to Census age groupings and rounded to the nearest 100 calories or 5 grams of protein.

What effects have these changes in age distribution had upon the (per capita) demand for food? This question cannot be answered definitively with existing data. However, the figures at the bottom of column 5 suggest that average daily calorie requirements of our population in 1953 may have been 3 or 4 percent lower than in 1940, assuming levels of physical activity and other relevant factors to have been the same in both years. If this difference in calorie requirements were distributed uniformly among all foods, the 1953 age distribution would give a per capita food consumption index 3 or 4 points lower than the distribution of 1940.[3] The calculation in column 6, subject to similar assumptions and limitations, suggests that the change in age distribution from 1940 to 1953 may have

[3] For example, civilian per capita food consumption in 1954 was 13 percent above the 1935-39 average. If the age distribution were the same as in 1940, per capita food consumption at existing prices *might* be 16 or 17 percent above 1935-39. This exhibit is far from conclusive, but it suggests to me that the change in age distribution *may* be partly responsible for the failure of per capita food consumption to reach the levels estimated in earlier economic projections, such as *What Peace Can Mean to American Farmers* (1945), and *Factors Relating to the Long-Range Prospect for American Agriculture* (1948). This situation will change over the next decade, as the proportion of total population in the 10 to 19 year age class increases.

reduced average protein requirements per capita by 2 or 3 percent. Granted our assumptions, we still do not know how to interpret a decline in protein requirements or even protein consumption into demands for individual farm products. For example, if children under 10 get a larger proportion of their protein from milk and adults get a larger proportion from cereals, the per capita draft on agricultural resources could be as high in 1953 as in 1940; that is, the average resource cost per gram of protein could be higher in the later year.[4]

2. *Geographic Distribution of Population.* Table 2 compares the 1940 and 1954 distributions of the United States population by regions. While

TABLE 2. GEOGRAPHIC DISTRIBUTION OF THE CIVILIAN POPULATION, UNITED STATES, 1940 AND 1954

Region	(1)	(2)	(3)	(4)	(5)
	Population distribution				Percent increase in actual population 1940 to 1954
	Actual		Percent		
	April 1 1940	April 1 1954	April 1 1940	April 1 1954	
	Millions	*Millions*	*Percent*	*Percent*	*Percent*
United States	131.7[1]	158.4[1,2]	100.0	100.0	20
New England	8.4	9.7	6.4	6.1	15
Middle Atlantic	27.5	31.2	20.9	19.7	13
East North Central	26.6	32.3	20.2	20.4	21
West North Central	13.5	14.4	10.3	9.1	7
South Atlantic	17.8	22.3	13.5	14.1	25
East South Central	10.8	11.5	8.2	7.3	7
West South Central	13.1	15.2	9.9	9.6	16
Mountain	4.2	5.6	3.2	3.5	35
Pacific	9.7	16.2	7.4	10.2	66

[1] Not adjusted for underenumeration of children. Based on *Farm Population—Migration to and from Farms, 1920–54*, Agricultural Marketing Service Report AMS-10, December 1954.
[2] Civilian population only.

population rose in all 9 regions, the increases ranged from 7 percent in the West North Central and East South Central regions to 66 percent on the Pacific Coast. The latter increase must be of tremendous im-

[4] The National Research Council also lists recommended daily dietary allowances for other nutrients, including calcium, iron, vitamin A, thiamine, riboflavin, niacin, ascorbic acid, and vitamin D. These requirements are given for each sex and for several different age groups. This suggests interesting applications of linear programming to determine least cost diets for families of different age and sex compositions. The least cost principle, of course, could be qualified to reflect something like normal food consumption patterns, as that not less than X grams of protein should come from the meat, poultry, and fish group, etc.

portance to marketing agencies within the region and to some if not all groups of agricultural producers.

Changes in geographic distribution of the population may not be very important, however, for statistical demand analyses based on national aggregates. Price differentials among regions will be affected substantially in some cases, as will the volume and pattern of interregional trade. But these changes will largely offset one another in terms of effects on national average prices and consumption.[5]

3. *Distribution of Population by Farm and Nonfarm Residence.* Table 3 shows the distribution of farm population by regions, in actual numbers and as a percentage of total regional population, for 1940 and 1954. Farm

TABLE 3. POPULATION BY REGION AND BY FARM AND NONFARM RESIDENCE, UNITED STATES, 1940 AND 1954[1]

Region	(1)	(2)	(3)	(4)
	Distribution of farm population			
			Percent of total population	
	April 1 1940	April 1 1954	April 1 1940	April 1 1954
	Thousands	*Thousands*	*Percent*	*Percent*
United States	30,547	21,890	23.2	13.8
New England	623	434	7.4	4.5
Middle Atlantic	1,788	1,491	6.5	4.8
East North Central	4,638	3,722	17.4	11.5
West North Central	4,711	3,360	34.9	23.3
South Atlantic	6,060	4,493	34.0	20.2
East South Central	5,283	3,693	49.0	32.0
West South Central	5,057	2,717	38.7	17.9
Mountain	1,118	794	26.9	14.2
Pacific	1,269	1,186	13.0	7.3

[1] Estimates for 1954 include civilian population only. Based on *Farm Population—Migration to and from Farms, 1920–54*, Agricultural Marketing Service Report AMS-10, December 1954.

population declined substantially in every region during the past 14 years, while total population increased. Farm population was 23.2 percent of the total in 1940 and only 13.8 percent in 1954; its relative importance declined about 40 percent.

Because of the ways in which official series on disposable income, food consumption, and retail food prices are constructed, shifts in population from farms to cities between 1940 and 1954 might affect the eco-

[5] These effects could be studied in the so-called spatial equilibrium model, which includes a demand curve and a supply curve for a given commodity in each region and a structure of transportation costs between all possible pairs of regions.

nomic significance of disposable income estimates by about 1 percent and retail food prices as a group by as much as 3 or 4 percent.[6] The relative decline in farm population since 1940 may have had striking effects on the national average consumption levels for a few individual foods. For example, a large proportion of the nation's consumption of sweetpotatoes and corn meal has been concentrated on Southern farms, and use of these seems to decline sharply when the same families move to town. Persons living on farms in the South constituted over 12 percent of the national population in 1940 and less than 7 percent in 1954. The national per capita figures show a decline of more than 50 percent in sweetpotato consumption and more than 40 percent in corn meal consumption since 1940, perhaps largely, though by no means wholly, due to the farm-nonfarm population shift.

4. *Family Size and Composition.* Relatively little information exists as to the effects of family size and composition upon food (or textile) consumption. Some analyses have been made in the United States and the United Kingdom indicating that per capita food expenditures decrease as family size increases for any given level of family income. This is certainly a plausible result. In the present context, however, it would be more relevant to know whether or not changes in family size and composition have had a significant effect on the average response of consumption to changes in price and income.

J. A. C. Brown in a recent article classified samples of roughly 3,000 British families into 16 different family types and estimated income elasticities of total food expenditure for each type.[7] He concluded that the differences in elasticities for the various family types were not clearly significant and that it was "possible to describe the food consumption behavior of households of widely varying compositions and incomes by a single behavioristic equation." Although future investigations might overturn this result, for the present there appears to be no basis for adjusting statistical demand analyses for the effects of family size and composition.

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[6] The practice of valuing farm consumption of home-grown food at farm prices and imputing the rental value of farm houses at a low level may also have a significant effect on State series such as per capita income payments to individuals. In 1954, the average farm family obtained about $350 worth of food and fuel from the farm valued at farm prices. The same quantity obtained through retail stores would have cost the family about $700. Similarly, the average rental value of a farm home in 1954 was imputed at $320, or about $27 a month. The same families would probably spend at least twice that amount for rent on a nonfarm dwelling. Hence, in a state that shows a sharper-than-average decline in farm population, we may get an increase in "per capita income payments" without an equivalent increase in the level of physical consumption.

[7] J. A. C. Brown, "The Consumption of Food in Relation to Household Composition and Income," *Econometrica*, Vol. 22, No. 4, October 1954, pp. 444-460.

5. *Summary on the Effects of Demographic Factors.* There are a number of demographic factors that could cause disturbances of from one to three or four percent in aggregative variables of the type used in demand analyses. But these effects apply to changes in the *levels* of specified variables between 1940 and 1954. Before concluding that these effects are of major importance, we should consider two things: First, we have not tried to determine if intercorrelations among the various demographic distributions might accentuate or offset the apparent effects of changes in particular distributions. Second, statistical demand analyses based on year-to-year changes should reflect only a fraction of the cumulative distortion that might appear in an analysis based on original values of the variables. For year-to-year forecasting based on first difference equations we would be concerned only with the effects of changes in these distributional factors between two adjacent years. It is not likely that any of these effects would rise above the level of statistical error in our published series on such a short-run basis.

B. *Changes in Economic Factors*

Most of the concern about continued applicability of demand analyses based on prewar data centers around changes in economic factors. In 1954 the consumer price index for all items stood at almost twice the 1940 level. Retail food prices were up even more. Disposable income per capita in 1954 (current dollars) was about 2¾ times the 1940 level. Also, much has been said about changes in income distribution and in the level and distribution of consumer assets. There have been striking changes in household appliances connected with food, in the size and layout of retail food stores, and in the form and packaging of various food products.

It is obvious that the world of 1955 is not the world of 1940; and yet I believe many of us have been overimpressed by the novel elements in the postwar situation and have underestimated the continuity of mass economic behavior. If we stop to think about it, we will probably recognize strong elements of continuity in our own economic behavior since we became adults—continuity in our professional aspirations, continuity in our desire for housing, automobiles, and recreation, continuity in our provisions for economic security, continuity in our food habits, and so on. If other people are like ourselves, it seems reasonable to believe that the structure of demand for farm products has undergone a gradual evolution rather than a dramatic upheaval.

We shall first examine the various economic factors that might affect the structure of consumer demand expressed at retail prices.

1. *The General Price Level.* Conceptually, deflation is the appropriate

data adjustment to meet the problem of changes in the general price level. An equal percentage change in all prices (including factor prices) should leave consumption patterns unchanged. All prices have not changed by the same percentage since 1940, but they have shown a strong central tendency. Changes in the relative *deflated* prices of competing commodities are a legitimate part of the demand analysis problem under prewar as well as postwar conditions.[8]

2. *Income Level and Distribution.* One of the relatively new and promising developments in demand analysis is the attempt to reconcile time series with family budget data. Family budget data for a given point in time can tell us a great deal about the relation of consumption and expenditures to income. They do not tell us anything very useful about the reaction of consumers to price.

Although there are many pitfalls in the interpretation of family budget data, let us assume for the moment that we have been able to measure the relationship of food consumption (from all sources, including restaurant meals, roadside purchases, etc. as well as food eaten at home) to family income. There are reasons for believing that this relationship will be roughly comparable to one obtained from time series data using deflated prices and incomes.[9] If so, a linear logarithmic relationship in the family budget data would suggest that the time series elasticity of consumption with respect to income was independent of both the average level and the size distribution of consumer income.

Family budget data indicate, however, that consumption of many foods increases at a decreasing rate as family income rises. If this relationship exists, income elasticity is different at different income levels. Hence, it

[8] Other data adjustments may have effects similar to deflation under certain circumstances. For example, per capita food consumption in 1954 was only 8 percent higher than in 1940, while retail food prices were up more than 100 percent. The theory underlying deflation suggests that percentage relations between price and consumption are likely to be fairly stable under these circumstances, but that arithmetic relations are not. This leads to a logarithmetic transformation of the prewar data. A further shift to first differences of logarithms materially reduces the effects of correlation between the "general price level" components of individual commodity prices and disposable income. Also, during the 1922-41 period, year-to-year changes in disposable income were dominated by the real component of such changes. The direct effect of changes in the real component on current-dollar disposable income was 4 times as great as the effect of changes in the price component. For these reasons I have generally used logarithmic first differences of undeflated data in my own prewar analyses.

[9] Richard Stone appears to be so convinced of this that he adjusts time series observations on consumption for the effects of changes in time series income on the basis of consumption-income regressions derived from budget data. The adjusted consumption estimates are then correlated with time series observations on price. See Richard Stone, *The Measurement of Consumers' Expenditure and Behavior in the United Kingdom, 1920-1938;* Volume 1, 1954, page 310.

seems intuitively probable that the weighted average income elasticity at any given time will be influenced by the average level of income, and possibly by its distribution. Specifically, the higher average level of real income at the present time (about 50 percent higher than 1940 on a per capita basis) would lead us to expect a lower income elasticity of consumption than prevailed on the average during the inter-war period.

As an exercise, let us consider a consumption-income relationship that reflects an elasticity of 0.60 at zero family income and declines by 0.05 for each $1,000 increase in family income, reaching zero at a family income level of $12,000. This is not too different from what one sees in family budget data for certain of the more income-elastic food products. This relationship was applied to family income distributions (in constant 1950 dollars) for 1935-36, 1941, 1944, and 1950, using average incomes for each quintile rounded to the nearest hundred dollars.[10] The weighted average of the income elasticities for the various quintiles was 0.44 in 1935-36, 0.40 in 1941, 0.34 in 1944, and 0.35 in 1950.[11]

Our constructed example suggests that income elasticities of food consumption in the postwar period may be moderately lower than the average for the inter-war years. If so, the extent must vary among commodities. Careful research may disclose significant, but not startling, changes in this particular type of demand coefficient.

3. *Level and Distribution of Consumer Assets.* To some economists, the striking feature about farm prices and incomes immediately after World War II was the extent to which forecasts based on prewar regression analyses were exceeded. The chief disturbance variables involved, including liquid assets and backlog demand for housing and consumer durables, were recognized but were generally treated in a qualitative fashion.

I have argued that to understand the abnormal demand for food during 1947 and 1948 it is helpful to divide so-called liquid assets of consumers into two components.[12] The first of these might be labeled volatile assets, namely, currency and demand deposits. The other component would include time deposits, government securities, and savings and

[10] These distributions were taken from "Size Distribution of Income Since the Mid-Thirties," by Selma Goldsmith, George Jaszi, Hyman Kaitz, and Maurice Liebenberg, *Review of Economics and Statistics*, Vol. 36, No. 1, Feb. 1954, pp. 1-32.

[11] One interesting thing results from the particular function assumed. Since we have assumed that income elasticity is a linear function of income, changes in income distribution have no effect on the weighted average elasticity. In other words, the average elasticity depends solely upon the average level of income. We cannot assume that this will be true in general; more complicated functional forms would imply an effect of income distribution independent of changes in the average income level.

[12] Karl A. Fox, *The Demand for Farm Products* (unpublished doctoral dissertation, University of California, 1952), pp. 163-172.

loan shares. Although any individual, and perhaps individuals in the aggregate, can readily transform assets from one category into another, I think the high level of volatile assets in 1947-48 indicated that consumers were prepared to spend at abnormal rates (relative to current income) for almost anything, including foods and other perishable goods. On the other hand, in view of the particular situation that existed during World War II, I would expect the other liquid assets to be more indicative of intentions to spend for housing and consumer durables or to hold for longer-term savings objectives.

Table 4 shows the results of some calculations relating to these liquid asset concepts. Unfortunately, we do not have long prewar time series on

TABLE 4. LIQUID ASSETS OF INDIVIDUALS, 1940–1953[1]

Year	(1) Time deposits, savings and loan shares, and U.S. Government securities	(2) Currency and demand deposits
	Percent of disposable income	*Percent of disposable income*
1940	45.0	15.8
1941	38.4	16.6
1942	34.9	18.2
1943	39.0	20.7
1944	46.0	23.4
1945	56.4	27.7
1946	59.4	29.6
1947	57.8	29.6
1948	53.5	26.4
1949	54.6	25.5
1950	50.5	23.2
1951	46.3	22.0
1952	45.4	22.1
1953	45.3	21.3
1954	46.8[2]	21.3[2]

[1] Excluding trust funds. Based on *Federal Reserve Bulletin*, July 1954, page 710. Asset figures are centered on July 1 by averaging published figures for December 31 of current and preceding years.
[2] Preliminary.

consumer assets. The slower assets were equivalent to 45 percent of disposable income as of 1940. This percentage rose to a peak of 59.4 percent in 1946 and declined rather rapidly thereafter. By 1951, the ratio of slower assets to disposable income was almost back at the 45 percent level, and changes in absolute values of the two variables from 1951 through 1953 have been roughly proportional. To me this suggests a relatively simple concept; that by and large consumers today are willing to make about the same percentage allocation of their total resources between current and long-run objectives as they were just prior to World War II. It also sug-

gests that the special backlog demand for housing and durable goods that existed in the earlier postwar years has been completely, or almost completely, dissipated.

Consumer assets in the form of currency and demand deposits amounted to about 16 percent of disposable income as of 1940. This percentage built up rapidly during World War II and reached a peak of nearly 30 percent in 1946-47. It fell rather rapidly during the next 3 years, reaching 23 percent in 1950, and declined to 21 percent in 1953. Possibly a still further reduction of this percentage will take place, but an alternative assumption is that the new normal level will be nearer 20 percent than 16 percent of disposable income.

The 21 percent level of 1953 *could* mean that consumers were slightly more willing to spend out of current income then than they were at the 16 percent level of 1940. I am by no means certain of this. However, the level of such assets during 1946-48 suggests to me that consumers may have been willing to spend from 10 to 15 percent more out of current income for services and nondurable goods (including food) than would have been expected from prewar relationships.

4. *Other Factors Affecting Consumer Demand.* Other factors of a still less measurable character may be affecting consumer demand. For example, we have gone through 15 consecutive years without a really damaging economic recession. The last two recessions, 1948-49 and 1953-54, demonstrated the ameliorative effects of built-in stabilizers, such as unemployment compensation, a progressive income tax structure, and farm price supports. Another factor, which may be more in the consciousness of businessmen than of individual consumers, is that economic stability has, during the past decade, become an explicit objective of national policy.

5. *Marketing Technology.* The effects of food technology on demand are easily over-rated. Consumption of new products, such as frozen fruits and vegetables, has increased largely at the expense of fresh and canned forms of the same primary commodities. Although the new product forms looks very different from the older ones at the retail store, many of these differences disappear when the product is set on the table. Changes in marketing practices may either increase or decrease marketing costs between farmer and consumer while many, but not all, save the housewife time and effort in food preparation. However, if all foods become increasingly more convenient to prepare at about the same rate, the relative demand for different foods (and the total demand for all foods) may not be greatly affected. The convenience of using poultry has probably increased more in the last 15 years than the convenience of using meat. Consumption of poultry meat is much higher than the prewar level, whereas until 1953-54 meat consumption was up only moderately. Al-

though these shifts in relative consumption have been reflected to some extent in the relative prices of the commodities, it is not clear that the demand functions themselves have been changed greatly by marketing practices.

This is not to say that changes in food technology have had *no* effects upon demand. The introduction of frozen fruits and vegetables has probably led to some increase in aggregate demand for these products at the farm level. Also, inventories of frozen products may now have some influence on prices received for the fresh forms, so we should be on the lookout for additional disturbances in our prewar single-equation analyses and possibly for some *bona fide* changes from single to multiple demand curve situations. The expanded use of deep freeze units in private homes may have had some effect on the short-run (month-to-month) elasticity of demand for some perishable products. In general, an increase in storage capacity relative to normal production seems likely to make aggregate demand (including demand for storage) more elastic and should therefore moderate the price impacts of changes in production.

6. *Summary on the Effects of Economic Factors.* We have discussed the possible effects of various economic factors on the structure of demand for food products. A change in the general level of retail prices should have no effect in itself on demand elasticities and other percentage relationships. Changes in the level and distribution of real incomes may have had significant but moderate effects on average income elasticities of consumption for various foods. These effects could vary, depending on the shape of the consumption-income relationship for each food, but in general I would expect that reductions in income elasticities are not more than 0.05 to 0.10. The level and distribution of consumer assets probably had a great deal to do with the abnormal demand for food during World War II and the immediate postwar years. By this time, however, assets have probably shaken down to a postwar normal level relative to disposable income, a percentage relationship not greatly different from that of the immediate prewar period. The fact that unusually large quantities of liquid assets were held by middle or lower income consumers during 1946-48 may have affected the consumption-income regressions for those years. However, I do not think that year-to-year changes in the distribution of liquid assets during the past three or four years have had any measurable effect on consumption-income relationships.

III. *The Consistency of Prewar Demand Structures with Postwar Observations*

A second method of investigating changes in the structure of demand is to test prewar analyses against postwar observations. Table 5 shows the results of such a test for several livestock products. The equations

used in the test were all fitted to logarithmic first differences of annual price, consumption and income observations for the 1922-41 period.

Column (1) contains standard errors of estimate calculated for the prewar period. If the underlying equations are equally applicable to current data, values estimated from the equations should come within one standard error of estimate of the actual values about two-thirds of the time and within two standard errors about 19 times out of 20.

TABLE 5. COMPARISONS BETWEEN ACTUAL YEAR-TO-YEAR CHANGES AND CHANGES ESTIMATED FROM 1922–41 REGRESSION EQUATIONS, SELECTED FARM AND FOOD PRODUCTS, 1952–54[1]

Commodity and variable estimated	(1)	Percentage change					
		From 1952 to 1953			From 1953 to 1954		
		(2)	(3)	(4)	(5)	(6)	(7)
	Standard error of estimate, 1922–41	Estimated	Actual	Actual minus estimated	Estimated	Actual	Actual minus estimated
	Percent	*Percent*[3]			*Percent*[3]		
1. *Retail price*[2]							
All meat	1.7	− 6.2	− 8.6	− 2.5	−0.9	− 0.7	0.2
Beef	2.9	−17.2	−23.6	− 7.7[4]	−2.5	− 3.6	−1.1
Pork	3.0	20.0	9.6	− 8.6[4]	5.2	1.6	−3.4
Pork (adj.)[5]	3.0	6.7	9.6	2.8	3.5	1.6	−1.8
Chicken	4.4	0.0	0.2	0.2	−2.3	− 8.0	−5.8
Eggs[6]	6.8	6.2	5.2	− 0.9	−6.9	−15.9	−9.6
2. *Farm Price*							
All meat animals	6.7	− 9.6	−11.3	− 1.8	−1.4	− 0.5	0.9
Cattle	7.5	−28.1	−33.0	− 6.9	−3.6	0.0	+3.6
Hogs	12.8	37.4	20.2	−12.5	9.1	3.3	−5.4
Hogs (adj.)[5]	12.8	11.9	20.2	7.4	6.2	3.3	−2.7
3. *Consumption*[2]							
All meat	n.a.	8.1	6.7	− 1.4	0.2	0.2	0.0
Beef	n.a.	30.9	25.0	− 4.5	4.2	3.5	−0.7
Pork	n.a.	− 4.5	−12.1	− 8.0	−1.6	− 4.7	−3.2
Pork (adj.)[5]	n.a.	−12.9	−12.1	0.9	−3.0	− 4.7	−1.8

[1] The regression equations are taken from Karl A. Fox, "Factors Affecting Farm Income, Farm Prices, and Food Consumption," *Agricultural Economics Research*, Vol. III, No. 3, July 1951, pp. 65–82.

[2] Equations include retail price, disposable personal income per capita, per capita consumption of the given commodity and, in some cases, per capita consumption of competing commodities.

[3] All percentages are calculated directly from logarithms; hence the figures in the "actual minus estimated" columns are not exactly equal to the differences between those in the "actual" and "estimated" columns.

[4] Difference greater than 2 standard errors of estimate.

[5] Adjustments assume that changes in consumption of beef, veal and lamb have the same percentage effect on pork price (or consumption) as the statistically estimated effects of consumption of pork, veal and lamb upon beef price (or consumption).

[6] Equation based on per capita production rather than consumption.

Two sets of estimates are given for pork and hogs. If we use the unadjusted prewar equations for these products, the box score for the 16 price estimates is as follows: 10 estimates within one standard error, 4 more off by less than two standard errors, and 2 off by more than two standard errors. If the adjusted equations for hogs and pork are substituted for the unadjusted, the scores become 12, 3, and 1 respectively. The first set of scores is a little worse than would be expected in the absence of structural change; the second set is a little better.[13]

Although the experiment represented by table 5 is of limited scope and significance, it tends to support the assumption that demand structures for major farm products have undergone only moderate changes in the past decade or so. For example, if we disregard sampling error entirely, the actual increase in beef consumption from 1952 to 1953 implies a demand elasticity about four-fifths as large as the 1922-41 average. The adjusted estimate for pork suggests no change, and the consumption change for all meat suggests an elasticity about five-sixths as large as the prewar average. At this point I would prefer to say simply that no definite changes in the prewar structures have been established.

IV. *Direct Measurement of Demand Structures from Postwar Data*

Price and consumption observations for many farm products were subject to unusual disturbances during World War II and the following two or three years of decontrol, inflation, and attrition of liquid assets. Other disturbances occurred during the Korean period due to price support and price ceiling effects. For some of the most important farm products, we have too few "normal" postwar observations to establish accurate demand functions from annual data.[14] We doubtless can obtain many coefficients that are significantly different from zero, but the standard errors will probably be too large for us to demonstrate that the postwar coefficients are significantly different from the prewar.

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[13] The nature of the adjusted estimates for pork and hogs is indicated in table 5, footnote 5. The arbitrariness of this non-statistical adjustment may be avoided by using demand functions for pork and beef fitted simultaneously to 1922-41 data under the constraint that the two cross-elasticities of demand be equal. Such demand functions are given in R. J. Foote and Karl A. Fox, *Analytical Tools for Measuring Demand*, Agriculture Handbook No. 64, January 1954, p. 17. These equations result in slightly worse estimates for beef and cattle than those shown in table 5, and in slightly better estimates for pork and hogs than the adjusted estimates in table 5. A set of 16 price estimates including those from the symmetrically-fitted equations gives a score of 11, 4 and 1 in terms of standard error ranges.

[14] This may not be true of all farm products. The prewar regressions for certain fresh fruits and vegetables worked reasonably well right through the World War II period and have continued to do so in the postwar periods. These particular products did not encounter rationing, effective price ceilings, or unusual military demands.

An alternative approach is available to the extent that we have estimates of food consumption for periods shorter than a year. The Agricultural Marketing Service has published quarterly estimates of meat consumption for several recent years. Rough quarterly estimates have been made unofficially for a few other products and quarterly estimates for still others could perhaps be made with better than random accuracy.

I see no reason why consumer demand functions for perishable food products based on quarterly data should be substantially different from those based on annual data. Certain methodological issues will have to be met. For example, how do we isolate possible seasonal shifts in demand? Shall we use seasonally-adjusted price and consumption data and assume that relationships based on them will be conceptually equivalent to those based on annual data? Shall we introduce a temperature variable into an equation based on unadjusted quarterly data, on the assumption that temperature affects the level of the quarterly demand function? Does the inverse relationship between the seasonal patterns in price and in consumption of eggs reflect movements along the same demand curve that is revealed by annual data? Or does this relationship represent a combination of movements along the demand curve and seasonal shifts in demand? Similar considerations would apply to the use of monthly data. However, it may not be possible to make satisfactory monthly estimates of final consumption from existing data on national aggregates.

Some exploratory work has been done with monthly data for particular markets rather than for the nation as a whole. In 1943 I fitted logarithmic equations to monthly unloads and prices of green peas at Chicago and New York City for the years 1939-41. The coefficients of determination were around 85 to 90 percent and the demand elasticities were from −1.4 to −2.1 measured at the terminal market level.[15] I was suspicious of these results at the time, as the only demand analyses I had seen or read about were based on annual data. More recently I have come to believe that if the residuals from such monthly regressions are not serially correlated, the regressions themselves should be subject to substantially the same interpretation as those derived from annual data.

Some promising data for direct measurement of postwar demand relationships are being obtained from consumer panels. Harold Riley and others at Michigan State College have been making extremely interesting analyses of panel data for families in Lansing, Michigan. Riley's analyses for meat, which are at present in an unpublished dissertation but will soon appear in technical bulletin form, are based on weekly data from

[15] These analyses are mentioned and further developed in D. Milton Shuffett, *The Demand and Price Structure for Selected Vegetables*, U. S. Department of Agriculture Technical Bulletin No. 1105, December 1954, pp. 84-89.

July 1951 through June 1953. Riley estimated the price elasticities of demand for beef and pork separately at about unity and the elasticity of demand for all meat at about –7. These results are extremely close to those obtained by other analysts from annual data for the prewar period. An added feature of Riley's analyses is the determination that temperature is a highly significant factor shifting the demand curve for meat from week to week.

V. *Implications of Structural Change for Price Analysis, Outlook Work, and Farm Policy*

Although I have mentioned a number of factors that should be re-examined in connection with current applications of prewar demand analyses, the arguments and illustrations I have advanced lead me to believe that most demand relationships for farm products have changed only moderately in the last 15 years. I am not prepared to recommend that each factor I have enumerated be converted into a specific adjustment (1 percent up for this factor, 3 percent down for this one, and so on) to be applied to prewar regression equations. Some of the demographic factors mentioned would simply change the levels (intercepts or constant terms) of demand functions slightly between 1940 and 1955. The effect of such changes on year-to-year forecasts from first difference equations would be much smaller than the 1 to 4 percent adjustments that might apply to the jump from 1940 to 1955.

There is perhaps a stronger case for adjusting consumption-income elasticities for changes in income level, if not in income distribution. However, this case needs checking for a number of different commodities, and the statistical significance of differences between consumption-income regressions from prewar and postwar budget studies should also be considered before making this type of adjustment.

Perhaps the most fruitful aggregative approach for the next year or two will be the analysis of postwar quarterly data for perishable commodities and settlement of the methodological questions that will be raised in comparing these results with the prewar analyses based on annual data.

Further exploration of consumer panel data appears to hold much promise, always depending, of course, on the accuracy of the basic observations obtained. An interesting question that might be tested is whether or not price elasticities of demand vary significantly among families at different income levels. In other words, is it possible that changes in income distribution affect price elasticities of demand as well as elasticities of consumption with respect to income?

In connection with agricultural outlook work, we should be prepared

to explain changes in regional price differentials and trade patterns as well as in national averages. Improvements in feeding and other practices should lead us to reexamine the relationships between feed consumption and livestock production, and between livestock numbers and prices and the derived demand for feed. Time lags may also have been affected since the prewar period by improvements in the handling of livestock.

In addition, there are some rather obvious structural features of the demand for farm products that must be watched and reevaluated from time to time. For example, we know that the demands for feeder cattle and replacement stock are at least partly independent of each other and of the demand for cattle for immediate slaughter. The demand for replacement stock seems to be subject to violent shifts near turning points in the cattle-numbers cycle; whereas the demand for feeder cattle is influenced by prices and supplies of feed in the Corn Belt. It should be helpful to formalize our knowledge of these relationships into a model involving three or more equations, instead of using a single equation representing demand for all cattle. (Please note that these equations may not have to be *derived* simultaneously; the point is that they would be *used* simultaneously to throw light on the workings of the cattle economy.) The demand for hatching eggs may also shift independently of the demands for eggs for immediate consumption or for storage; a model (statistically fitted if possible, partly synthetic if need be) reflecting these separate demands might help us to avoid surprises in outlook work on eggs.

For export crops, such as wheat, cotton, tobacco, and rice, we must be on the lookout for changes in both the export and domestic demand structures. We should be aware also that although an effective price support program invalidates the use of price as a dependent variable, we may still obtain useful knowledge by treating consumption and/or exports as variables dependent on the supported price.

Changes in world trading practices and international political relationships may have substantially altered the sorts of policies we can hope to maintain or use with respect to our export commodities. The decline in the relative importance of farm people in the total population may also have significant effects upon the political strength and strategy of farm groups. However, I doubt that changes in the structure of domestic demand for farm products over the past 15 years have been sufficient in themselves to justify changes in appropriate agricultural policies. The relative costs and benefits of different price support methods, the income-raising effects of food allotment plans and marketing agreements, and other evaluations turning on demand elasticities would probably line up today much as they would have done in 1940.

A STATISTICAL ANALYSIS OF FACTORS THAT AFFECT PRICES OF COFFEE*

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EARLY in 1954 the price of coffee went up sharply. Spot prices for Santos 4 at New York advanced from 62 cents per pound in mid-December 1953 to a peak of 72.5 cents in mid-January 1954. This price rise followed a substantial price rise in the latter part of 1950; the spot price was 57 cents in July 1950, compared with 25 cents in January 1949.

These price rises have been the subject of considerable public concern. Not only were they sudden and substantial, but the prices attained set new record highs. The question was immediately raised as to whether or not the price rises were justified by the supply and demand situation. A statistical analysis designed to answer the question is discussed in this paper. This study is of interest not only because it contributes to an understanding of recent developments that affected prices of coffee but also because the analysis contains several statistical innovations.

General Approach

A number of obstacles confront research analysts who wish to use statistical methods to study economic factors that affect coffee. The data, particularly those that relate to supply, are known to be imprecise. Many institutional factors that are difficult to measure statistically, such as special exchange arrangements by the Brazilian government, have affected prices. No published data are available on actual amounts moving into consumption; series that are commonly referred to as "consumption" are actually disappearance into trade channels. Finally, a variety of factors such as changes in tastes, availability of substitutes, and hours of work, in addition to those normally included in a supply-price analysis, have affected consumption or disappearance. These factors cannot be adequately represented by available data or by use of a simple time variable.

These difficulties apparently have been sufficiently serious to discourage research analysts for, so far as the authors know, no studies dealing with factors that affect world prices of this important commodity have recently been made. The Food and Agriculture Organization of the United Nations

* A popular description of this study, including the data used in the analysis, was published by the Foreign Agricultural Service under the following title: "Supply and Demand in Relation to the Price of Coffee," Foreign Agriculture Circular FCB 30-54, Dec. 16, 1954.

has recently published a statistical study of factors that affect consumption of coffee in the United States.[1]

A number of alternative price series were considered. Brazil is the leading producer and exporter of coffee in the world. But prices there have been subject to a great many exceedingly complex exchange regulations, so that it would be difficult to convert these prices to make them comparable to those in the principal importing countries. The United States is the principal importer. However, no uniform long-term series of retail or wholesale prices in this country are available, and even if they were available, they would not reflect changes in the types of coffee consumed. On the other hand, import value is declared by importers on every shipment entering this country for consumption. This value is the foreign or export value, whichever is higher. In general, it approximates a value f.o.b. the exporting country. Transportation costs and United States customs duties are excluded.

The total declared value of all coffee imported during the year divided by the total quantity imported, therefore, gives a long-term price measure on a common basis of the average import value of all coffee consumed. Use of a price series of this type means that the analysis is concerned with prices that importers pay for the kind of coffee actually used in this country rather than for coffee of a specified quality only. Since the quality of coffee used has changed considerably since 1882, this distinction is important, particularly as it relates to the time factor introduced into the analysis.

Because of known inaccuracies in the data on supply and disappearance and the many extraneous factors that have affected the coffee economy, many years are required to obtain statistically-significant results for the more important causal factors. The present analysis is therefore based on data going back as far as good data are available. It covers the crop years from 1882 through 1949 (beginning in July and ending the following June, since that is the marketing year in Brazil), with the following omissions: 1890-91, because of devaluation of the Brazilian cruzeiro, which resulted in import values far out of line with actual prices in the United States; 1914-17, because of abnormally low consumption in Europe; and 1940-46, because of Government price regulations in this country. The years after 1949 were omitted, as the analysis was designed to test whether price rises taking place in those years were in accordance with expectations based on historical data.

The equation was constructed by expressing each of the factors relating to supply as a ratio to an appropriate factor relating to demand. Thus the analysis became basically a relationship between two types of variables—

[1] A. Szarf, and F. Pignalosa, "Factors Affecting United States Coffee Consumption." Monthly Bul. of Agr. Econ. and Statis. 3(10): 6-10, Oct. 1954.

(1) price and (2) supply deflated by demand—but because there is more than one supply factor, a multiple regression equation is required. A time-factor also was included and found significant.

Variables

The following variables were used initially in the analysis, with those relating to quantities of coffee expressed in million bags:

X_1—Average import value in cents per pound in current year divided by personal disposable income per capita in dollars, in logarithms. Each factor was expressed as a percentage of its 1947-49 average. These averages are 25.4 cents for import value and 1,238 dollars for income.

X_2—Available world stocks at start of current year divided by average world imports or deliveries for the 5 preceding years, with the ratio multiplied by 10, in logarithms.

X_3—Available Brazilian exportable production in current year divided by average Brazilian exports for the 5 preceding years, with the ratio multiplied by 10, in logarithms.

X_4—Available Brazilian exportable production in the following year divided by the same factor as used for X_3, with the ratio multiplied by 10, in logarithms.

X_5—Exportable production outside of Brazil in the current year divided by average exportable production outside of Brazil for the 5 preceding years, with the ratio multiplied by 10, in logarithms.

X_6—Time, current year -1882.

Disposable income per capita was selected as a deflator for import value because it reflects changes in both real income and price level, the principal factors that cause shifts in demand for coffee in this country. This series, as published by the Agricultural Marketing Service, goes back only to 1909. A comparable index for the full period of the study was developed by joining the AMS index from 1909 to date with indexes of daily and weekly earnings from 1882 to 1908.[2] For recent years, the AMS series is based on that regularly published by the Department of Commerce. The combined series was converted to index numbers largely as a matter of convenience. One way in which X_1 can be interpreted is that it indicates how expensive coffee is after considering the number of dollars people have to spend for all items.

During the 1930's and 1940's, a substantial amount of Brazilian coffee was pledged as security for a Coffee Realization Loan.[3] These stocks were not available for commerce and were subtracted from total world stocks

[2] The following data were used: 1883-89, index of average wages per day, non-agricultural employments, series D108, and 1890-1908, index of average full-time weekly earnings, all manufacturing, series D113, *Historical Statistics of the United States, 1789-1945,* U. S. Bureau of the Census, 1949. Data for calendar years corresponding to the second half of the fiscal years were used prior to 1917.

[3] See V. D. Wickizer, *The World Coffee Economy with Special Reference to Control Schemes.* Stanford Univ. Press, 1943.

in computing X_2. Pledged stocks withdrawn from the market were subtracted from Brazilian exportable production, and pledged stocks released to the market were added to production in computing X_3 and X_4. This explains the meaning of the word "available" as used with these variables.

Since world consumption of coffee has been increasing over the years included in the analysis, the level of stocks needs to be considered relative to the level of consumption. Hence it is logical to use the ratio of world stocks to world deliveries or consumption. Recent exports were used as a deflator for Brazilian production for the same reason. Data on world stocks and world deliveries through about 1946 were obtained from the New York Coffee and Sugar Exchange. More recent data and those for Brazilian production and exports were obtained from the Foreign Agricultural Service.

Brazilian production in the following year was used in the analysis, because production tends to follow a 2-year cycle and it was assumed that market operators might take into account forecasts for the following year in appraising prices for the current year. Production outside Brazil was divided by the value of this series in the preceding 5 years, because most exportable coffee produced by these countries is exported in the same marketing year as it is produced. Hence exports and exportable production can be assumed to be approximately identical, so that the same kind of factor was used as a deflator for both X_3 and X_5.

Both X_4 and X_5 showed a positive relation to price after allowing for the effects of the other factors in the analysis, but in each case the standard error of the regression coefficient was about as large as the coefficient itself. Since they were non-significant, these variables were omitted from the final analysis. Variations in these series over the years used in the study apparently have been too small to permit statistical measurement of their economic effects with available data.

The Regression Equation

The following results were obtained when the variables were fitted for the period 1882-1949, omitting the years previously mentioned. The variables X_4 and X_5 and their nonsignificant coefficients have been omitted in this equation. The numbers in parentheses under the regression coefficients are their respective standard errors.

$$X_1 = 1.99 - \underset{(0.07)}{0.36}\, X_2 - \underset{(0.13)}{0.42}\, X_3 - \underset{(0.0008)}{0.0045}\, X_4 \qquad R^2 = 0.70.$$

In this equation, the coefficients for X_2 and X_3 have the expected negative sign and differ significantly from zero. The two coefficients are of about the same magnitude, indicating that a 1-percent change in each has about an equal effect on X_1. These coefficients probably cannot be inter-

preted directly as price flexibilities because of the deflators used for both the dependent and independent variables.

The coefficient on time (X_6) can be translated into meaningful terms by the following method: Subtract the value of the coefficient, 0.0045, from 2, since the sign is negative, and look up the antilogarithm of the result. This is approximately 99. Then subtract this value from 100, giving 1. This indicates that if all of the independent variables in the analysis and disposable income remain unchanged, the price of coffee would be expected to decline by about 1 percent per year.

The Unexplained Residuals

When the unexplained residuals were plotted against time as a check on the degree of serial correlation, it was found that they followed a definite cyclical pattern. A similar cyclical pattern was found in the unexplained residuals from an analysis made by the Agricultural Marketing Service of factors that affect prices of edible fats and oils.[4] In that analysis, use of the change in price from the previous year as an additional variable in the analysis was found to result in residuals that were not serially correlated. For coffee, however, use of the change in price as an additional independent variable had practically no effect on the regression equation or the residuals.

The economic justification for the procedure used in the study of fats and oils is as follows: When prices of these commodities rise, manufacturers and dealers tend to build up their stocks, so that the demand at the wholesale level is greater than that represented by direct movement into consumption. If such stocks have accumulated, a reverse effect takes place when prices decline. Manufacturers and dealers tend to reduce their stocks, so that demand at the wholesale level is less than that represented by direct consumption. Thus the direction in which prices are changing affects the level of prices.

Further study of the unexplained residuals for the analysis of coffee prices indicated that in general they are positive when prices are rising or remain relatively high and they are negative when prices are declining or remain relatively low. If these are designated as inflationary and deflationary periods, respectively, 18 out of 20 residuals for the inflationary years were positive and 25 out of 34 residuals for the deflationary years were negative. On the average, prices were 21 percent higher during inflationary periods than would have been expected from the regression equation and 11 percent lower during deflationary periods. In terms of logarithms, 0.0826 should be added during inflationary years and 0.0486

[4] Sidney J. Armore, "The Demand and Price Structure for Food Fats and Oils." U. S. Dept. Agr. Tech. Bul. 1068, 1953, pp. 30, 57-58.

should be subtracted during deflationary periods. When the computed prices were adjusted in this way, the percentage of variation explained by the analysis was increased from 70 to 84 percent. This improvement by stratification of the variation into these 2 classes was highly significant statistically.

The economic explanation of this appears to be similar to that for fats and oils. When supplies are declining, efforts are made to maintain coffee inventories, and prices tend to be higher than would be expected from the level of supply in relation to current consumption. When supplies are increasing, inventories can be reduced; hence prices tend to be lower than would be expected based on relative supplies.

The only notable exception to this cyclical effect was during 1931-34. In this deflationary period, prices declined, but they did not fall as low as would have been expected based on the original regression equation. In the extreme situation that existed at that time, when values fell exceptionally low as supply reached an all-time peak in relation to consumption, some market resistance apparently developed to further price declines.

Application to Recent Years

Table 1 compares actual prices during the years beginning 1949-53 with those indicated by the analysis with and without an allowance for cyclical position. Based on the supply-demand factors alone, a substantial

TABLE 1. COFFEE: AVERAGE IMPORT VALUE PER POUND, ACTUAL AND COMPUTED, 1949-53

Year beginning July	Actual	Computed with—	
		No allowance for cyclic position	Allowance for cyclic position
	Cents	*Cents*	*Cents*
1949	33.9	30.2	36.4
1950	48.8	32.4	39.3
1951	51.2	39.2	47.3
1952	51.5	43.6	52.7
1953	58.6	47.6	57.6

rise in prices would have been expected during this period. However, this rise was accentuated by the additional factors normally associated with a period of decreasing supply. The average difference between the actual and adjusted computed values is well within the range of error that would be expected based on the years used in the analysis. The standard error of estimate for the adjusted analysis when translated into percentage terms is 16 percent, and the standard errors of forecast for these years averages about 21 percent. A comparable error measurement for 1949-53 is 11 percent.

It will be noted that actual prices during the year beginning 1950 rose considerably more than would have been expected from the equation, probably reflecting the outbreak of hostilities in Korea. Actual prices led computed prices slightly in 1951. But by 1952, actual and computed prices were nearly the same, and this held also in 1953.

The data in table 1 clearly show the effect of cyclical position on prices of coffee. Factors relating directly to supply and demand were the principal cause of the rise in price. But the analysis suggests that prices by 1953 were increased by an additional 10 cents per pound owing to the cyclical position of the market.

Effect of Price on Supply

One of the most striking aspects of the coffee economy is the recurring pattern of high prices, followed by increasing supply, then by declining prices, and often later by decreasing production. This cycle is evident in figure 1, which shows import value and Brazilian exportable coffee production from 1870 to 1953. This figure is plotted by 2-year averages in order to equalize for biennial bearing of the coffee trees.

Six major price-rise periods are evident in this chart, beginning in 1872, 1886, 1910, 1918, 1924, and 1941. Each of them was associated with increased Brazilian exportable production several years later, but the length of lag has not been consistent. (See table 2.) Considerable variation in the lag between price rises and production increases is quite understandable. Increased prices can fairly quickly affect production when the response to them is rejuvenation of run-down plantations; but their effect is much slower when the increased prices stimulate planting activity. Furthermore, the period of lag must certainly be affected by planters' judgments as to the business outlook. In addition, irregularity in yields due to weather conditions can cause the turning point for production to take place one or more years later or earlier than would be expected based on economic conditions alone.

TABLE 2. COFFEE: FIRST YEAR OF INCREASE IN CYCLES OF IMPORT VALUE PER POUND AND OF BRAZILIAN EXPORTABLE PRODUCTION, 1870–1953

Year beginning July		Lag in years
Import value	Production	
		Number
1872	1878	6
1886	1896	10
1910	1913	3
1918	1920	2
1924	1927	3
1941	1945	4
Average		5

Declining prices have not affected production as consistently as rising prices. In the 1930's, declining prices associated with large world stocks coincided with a period of economic depression. World consumption did not increase materially despite reduced prices. By 1940 the effect of continued low prices was evident in markedly reduced production. The other extended period of declining prices, 1896-1909, was also begun by a reduction in consumer income, but the recession was of short duration; by 1900 income was rising, and it continued to rise for the next 10 years. Increased income and reduced coffee prices stimulated consumption to the point that stocks readjusted by 1910 despite only a moderate decrease in production. The other periods of declining prices, notably 1878-85, 1913-17, and 1920-23, were of relatively short duration. The effect on production and consumption was small and not as obvious.

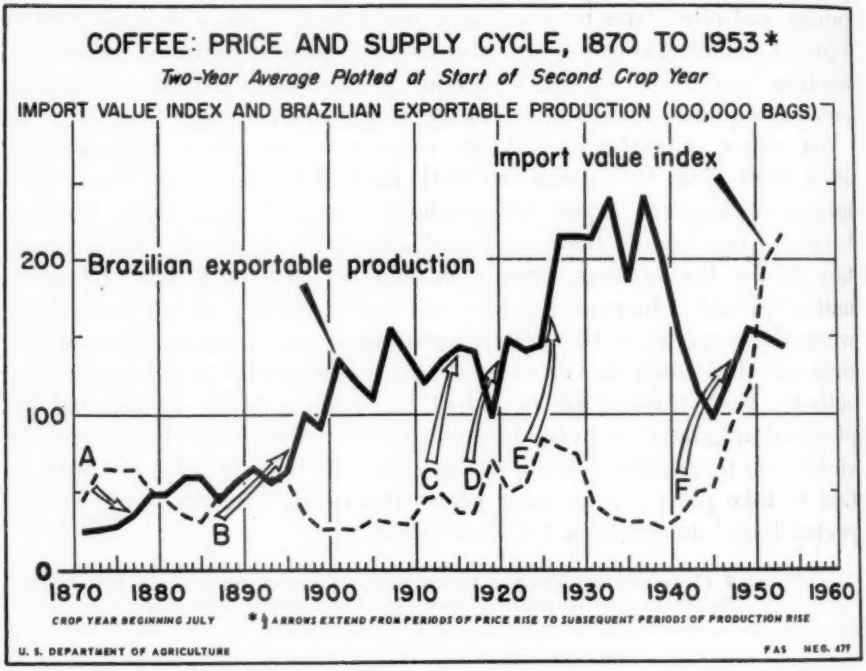

FIG. 1. COFFEE: PRICE AND SUPPLY. ARROWS EXTEND FROM PERIODS OF RISING PRICES TO SUBSEQUENT PERIODS OF INCREASING PRODUCTION. BASED ON 2-YEAR AVERAGES.

It appears, then, that the consequences of declining prices on production have depended in large measure on the general economic situation in consuming countries. When the economic situation remained favorable, consumption responded to reduced prices; greater consumption then be-

came a more potent factor than declining production in reducing the extremely large stocks.

Since 1949, prices have been rising, reflecting the progressively declining supply-consumption ratio. Based on the average lag of 5 years in production response, production would be expected to start to increase by about 1954. Recent estimates of production published by the Foreign Agricultural Service indicate that this is taking place.[5] During 1946-50, world exportable production averaged 28.9 million bags. In the current marketing year, production of 33.7 million bags is expected. Brazilian exportable production for the year beginning July 1954 is estimated at 14.9 million bags, up 0.6 million bags from the preceding year. Production is expected to increase by an additional 2.5 million to 3.5 million bags in 1955-56 and further increases are expected in subsequent years. These are a consequence of plantings made in the last several years.

With a higher supply-consumption ratio, lower coffee prices would be expected.[6] If the present favorable level of consumer income continues, some increase in coffee consumption would then be anticipated.

Summary and Conclusions

The principal factors associated with deflated import value per pound for coffee during 1882-1949 were found to be: (a) Available world stocks at the start of the marketing year in relation to current levels of world consumption, and (b) available Brazilian exportable production in relation to current levels of Brazilian exports. The fluctuations associated with these supply and demand factors have been accentuated by the cyclic position of the market—in inflationary periods, prices went 21 percent higher on the average than would be expected from the supply-and-demand factors alone; in deflationary periods, they averaged 11 percent lower. When the adjusted equation was applied to data for recent years, it was found that the recent increases in import value were in line with historical expectations.

Wide fluctuations in import value are disconcerting to both producers and consumers. While cyclical position historically has had less effect on price than have supply-demand factors, it is especially significant because it causes prices to go lower in periods when they are low and to go higher in periods when they are high. Those concerned with coffee prices might therefore give attention to the reasons for the cyclical effects and to means of reducing their magnitude.

Uncertainties regarding future supply and demand conditions are be-

[5] "World Coffee Production for 1954-55 now Forecast at 41.8 Million Bags," Foreign Agriculture Circular FCB 29-54, Dec. 16, 1954.

[6] Data not available at the time the manuscript was prepared indicate that the expected price decline materialized at the start of 1955.

lieved to be a major factor in causing that part of the swing in prices attributable to cyclical effects. When supplies are relatively low, roasters tend to fear that they will be unable to obtain sufficient high-quality coffee to meet their needs and hence they tend to bid up the price to an unduly high level. When supplies are more than ample, buyers can bring pressure on sellers and hence depress prices by more than the amount indicated directly by the supply-demand situation. If better knowledge were available regarding future prospects for both supply and demand, it is possible that the magnitude of these cyclical factors would be reduced.

The study shows that the supply situation, which is at the root of the violent price swings, has largely been self-adjusting. Periods of rapidly rising prices have in the past been followed by increased production within an average of 5 years. This has tended to bring about a gradual increase in stocks and, ultimately, declining real prices. Recent information indicates that the current period will be no exception to this historic pattern. The process of self-adjustment on a rising market is complicated by the time lag before new coffee trees come into bearing. In the meantime, uncertainty of future supply forces the market into an extreme price position, and this in turn may stimulate overplanting.

Past records of production show that at the very time when prices are reaching their peak level, the supply situation is on its way to self-adjustment. Yet the predicting equation suggests that traders and planters govern their actions almost entirely by the momentary supply and price situation. The supply situation that develops in the immediate future has no significant effect on current prices.[7]

Difficulties that the trade has in assessing future supplies of coffee accurately is not surprising. Production of even a current crop is generally not well estimated in the coffee-producing countries; estimates by different agencies often differ widely. Forecasts of future crops are even more unreliable. Yet this situation is not inevitable. Accurate estimates of future production probably could be made by putting greater emphasis on crop-estimating surveys in plantations. Such estimates, if regularly available and properly interpreted, could help to reduce the aggravating effect of cyclic position on price. They might also assist in keeping plantings more in line with prospective long-term demand. This approach holds promise of smoothing out some of the extreme swings in coffee prices that are disturbing to planters, traders, and consumers.

[7] In the production of cattle in the United States, and possibly elsewhere, a similar over-responsiveness to current prices adds to cyclical fluctuation in numbers and output. In recent years, this has been moderated to some extent by sound outlook information.

AGRICULTURAL INTEREST IN THE REGULATION OF TRUCK TRANSPORTATION

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THE exemption of agricultural commodities in interstate transportation from major price and rate provisions of the Motor Carrier Act, 1935, is entitled to more attention than it has received. As the result of a relatively free market determination of rates, together with free entry and free choice of operating routes and schedules, a large number of owner-drivers and small trucking concerns has become engaged in interstate agricultural transportation that is exempt by law from economic regulation by the Interstate Commerce Commission. The level of rates is different from that in the part of the transportation industry more thoroughly regulated by the ICC.[1]

Although the entire structure of the truck transportation industry is affected by the exemption, the net social costs and benefits of the exemption are not easily measured. Shippers of agricultural commodities and farm organizations claim that the exemption benefits agriculture at the expense of no one. If this claim is valid, a shadow is cast over the entire system of transportation regulation by the suggestion that net general welfare benefits would accrue in abandoning ICC regulation elsewhere. If the claim is not valid, then the question arises as to whether or not transportation of agricultural commodities is so markedly different from that of all other commodities as to justify a completely different system of regulation.

Passage of the Motor Carrier Act, 1935

Development of the provision relating to agriculture dates from the action taken in 1935. Prior to this date, several states had tried to regulate interstate motor transportation, but such attempts had little effect on interstate traffic since control could be attacked successfully in the courts as an invasion of interstate commerce where regulatory power was reserved to the federal government. President Roosevelt included transportation among the problems to be attacked by his Administration. His coordinator of transportation, Joseph B. Eastman, made a series of pro-

* Giannini Foundation Paper No. 145.

[1] Under the provisions of the Motor Carrier Act, 1935, all interstate motor carriers are subject to regulation in such matters as hours of service of drivers and equipment standards relating to safety. The exemption to which this report refers is exemption from economic or price and rate regulation.

posals to Congress in 1934-35 on reorganization of railroads, motor, water, and air carriers. In his report of January 30, 1935, Eastman made proposals for federal regulation of motor carriers and for sweeping changes in the ICC. Bills were later introduced in Congress to implement his proposals.[2]

The agricultural exemption was not part of the original proposal by Eastman and was generally opposed by representatives of the transportation industry and by middlemen dealing in agricultural commodities. At the congressional hearings, Clark Drury, chairman of the trucking committee of the American Fruit and Vegetable Shippers Association (a middlemen's group), spoke in favor of federal regulation and urged its extension to cover itinerant truck peddlers who were then a threat to the established business houses his association represented.[3]

The farm organizations, on the other hand, were solidly in opposition to trucking regulation, and they won their point.[4] When the Act was passed, it contained the following exemption:[5]

> Nothing in this part, except the provisions of section 204, relative to qualifications and maximum hours of service of employees and safety of operation or standards of equipment shall be construed to include . . . (4a) motor vehicles controlled or operated by any farmer, and used in the transportation of his agricultural commodities and products thereof, or in the transportation of supplies to his farm or (4b) motor vehicles controlled and operated by a cooperative association as defined in the agricultural marketing act approved June 15, 1929, as amended . . . (6) motor vehicles used exclusively in carrying livestock, fish (including shell fish) or agricultural commodities (not including manufactured products thereof).

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[2] This followed the over-all report of March, 1934. The ICC had proposed earlier that regulation of interstate motor carriers be inaugurated. See *Motor Truck and Motor Bus Operations*, 140 ICC 685 (April 10, 1928), and *Coordination of Motor Transportation*, 182 ICC 263 (April 6, 1932). Eastman's report is Senate Document 152, 73d Congress, 2d Session.

[3] In general, this was the position of agricultural middlemen at that time. Others testifying in favor of control of itinerant truck peddlers were W. R. Scott, representing the Kansas Board of Trade and the Southwest Grain Trade, D. O. Milligan of the Western Grain and Feed Dealers Association, H. D. Filson of the Colorado Potato Growers Association, and J. R. Van Arnum of the National League of Wholesale Fresh Fruit and Vegetable Distributors. T. P. O'Brien of the International Brotherhood of Teamsters also favored regulation. Mr. Drury's testimony is in sharp contrast with the current strong opposition of the same interests to any extension of federal regulation of trucking.

[4] The opponents included the National Grange, the National Cooperative Milk Producers Association, the American Association of Creamery Butter Manufacturers, the Farm Bureau Federation, the American Livestock Producers Association, the National Woolgrowers Association, the American Port Cotton Compress and Warehouse Association, the National Cooperative Milk Producers Federation, and the National Dairy Union. See *Traffic World*, Vol. LV, p. 739, for a summary of this opposition.

[5] This was part of section 203(b). For the complete text of the Act, see U. S. Code (1952), title 49. Section 303(b)(6) is the same as section 203(b)(6) of the Act.

This exemption proved to be somewhat ambiguous and its intended coverage has never been clearly determined even though a detailed list of exempt commodities has been developed by the ICC.[6]

At first, Eastman and the ICC had tried to quiet farm opposition by pointing out that casual or reciprocal transportation by those for whom transportation was not a regular business was excluded from regulation. This ruling had been described as exempting farmers who might transport supplies or crops for neighbors and local businessmen. Although the farm organizations undoubtedly considered this exemption to be an important concession, their opposition to regulation continued. What the farm groups apparently wanted was either exemption of professional truckers engaged in hauling agricultural products or complete abandonment of the system of regulation. The ICC's disclaimer of any desire to regulate farm trucks was essentially a diversionary tactic that did not succeed in quieting farm organization opposition.

The new law fell far short of Eastman's proposals. Not only did the exemption cover an important percentage of all traffic, but the availability of a large volume of unregulated, revenue-producing traffic helped support many small truckers who did not or could not get ICC authorization to act as common or contract carriers. These small truckers had existed before 1935 and had been considered by the larger, better established trucking concerns to be an undesirable element. Known as gypsies, the small truckers were characterized by irregular operation, frequent shifting among territories, rate cutting, and a high rate of business turnover. Many truckers of exempt commodities today are the direct descendants of this group.

Reasons for Demanding Special Consideration

To many people in agriculture, the whole structure of transportation regulation, substituting as it does close economic control for the workings of competition, has long been suspect. The position of farm organization spokesmen has been that if the transportation industry desired to submit to an unsound system of regulation it should leave agricultural transportation out. The perishability of agricultural products, the irregularity and seasonality of agricultural marketing, and the depressed prices that farmers sometimes receive have been points mentioned. Opponents of regulation have also held that authorized carriers operating on fixed

[6] See ICC MC968, *Determination of Exempted Agricultural Commodities.* This list developed out of a rehearing of the case of Norman E. Harwoods' application for a permit to haul prepackaged spinach started in Washington, November 9, 1948. By granting him a permit, the ICC had in effect ruled this spinach not to be an exempt commodity. In the rehearing, requested by the Secretary of Agriculture and others, a list of exempt commodities was developed. This followed the earlier determination in the Monark Egg Case, 44 MCC 15.

routes and at fixed rates are, by their nature, unable to meet the demand for agricultural transportation in a sufficiently flexible manner or at as low cost as a freer transportation industry. These arguments are probably of special significance in fresh fruit and vegetable marketing where the uncertainty of production and the short season of many crops create heavy peak demands.

The most important influence in the development of the agricultural position probably was the feeling that transportation costs would be lower if a large number of small exempt truckers were free to compete on a price basis. This argument apparently was valid in 1935 and probably is today as indicated by the difficulty with which authorized carriers compete for exempt traffic with the many small, unregulated operators. The small amounts of exempt commodity traffic that authorized carriers haul usually come their way at peaks of the shipping season when there is a scarcity of the small independent truckers specializing in exempt commodity transportation. Testimony to the effect that trip leasing of these same small operators, by authorized carriers, is at the root of rate cutting has been presented frequently at ICC hearings. Some holders of authorizations actually do not own trucks at all but rely exclusively on trip leasing, apparently finding it cheaper to obtain trucks in this way than to operate their own fleets.

The Trip-lease Controversy

The heart of the argument over control has to do with the practice of trip leasing. The round-trip character of much transportation is such that costs of a service, such as transporting commodities from A to B, depend on the revenue that can be obtained by transporting other commodities from B to A. If the ICC can determine who may transport from B to A, costs of transportation from A to B will also be affected even if not specifically regulated. Shippers of agricultural products are thus interested in ICC policy even when movement of their own goods is exempt from ICC regulation.

The argument has flared anew since 1948 when proposals came from the ICC for more inclusive regulations on the leasing of trucks, interchange of equipment among carriers, and record keeping in connection with the same.[7] While this proposal did not refer to the exempt haulers, the activities of this group played a prominent part in the subsequent hearings.

The important part of the proposal from the point of view of agriculture was the requirement that leases of equipment not owned by authorized carriers, when the driver of the equipment was its owner or his employee,

must be made for a duration of 30 days or more. Most important of the other provisions was the prohibition of the practice of paying the driver-owner of a leased truck a percentage of whatever revenue the truck earned. Additional technical provisions firmly established the responsibility of the leasing carrier for all use made of the truck during the term of the lease. Interchange of equipment among carriers—a quite different matter from trip lease—was also covered in the ICC proposals.

Although many of the important provisions of the proposal were generally acceptable to the trucking industry and to shippers, opposition of farm organizations and exempt truckers developed, based on the proposed limitation on the nonagricultural use of exempt truckers. Exempt truckers were to be as free to lease or be leased as before so long as they hauled exempt commodities; but they would be considerably restricted in leasing their trucks to authorized carriers for short periods for nonexempt hauling. Agricultural interests saw this as a restriction in the supply of trucking available to them. The main argument used was probable interference with the benefits agriculture derived from the exemption granted in the 1935 Act.

Requests for rehearings repeatedly delayed the date for putting the ICC's proposal into effect. Upon failure to persuade the courts to declare the proposal beyond the power delegated to the ICC in the Motor Carrier Act, farm organizations and agricultural commodity middlemen, abetted by trucking interests, shifted to congressional action. A bill introduced by Senator Tobey on February 13, 1953 would have denied the ICC power to specify the duration or manner of compensation in leasing; and a house resolution, introduced by Representative Wolverton, was much the same. While the fate of these bills remained undecided, the ICC postponed the beginning date of the trip-lease portions of its proposal to March, 1956.

The ICC shifted ground during the course of the controversy in an unsuccessful attempt to placate the farm organizations. Farmers were assured that use of their own trucks for casual transportation would not be affected and that they could lease their equipment to authorized carriers for any period of time.[8] The ICC added an amendment to the proposals exempting trucks of agricultural cooperatives from the trip-lease restriction. Later the exemption was extended to cover truckers

[7] Ex parte No. MC43, January 9, 1948, published in the *Federal Register*, Vol. 13, p. 369f.

[8] Testimony of Commissioner Knudson before the House Interstate and Foreign Commerce Committee on May 7, 1953. *Hearings before House Committee on Interstate and Foreign Commerce on Trip Leasing* (House Resolution 3203), p. 434 (83d Congress, 1st Session).

who had just completed a trip hauling exempt agricultural commodities and who were to move toward the area where the exempt load had originated or toward their own headquarters.[9] Opponents of the regulations, including the Secretary of Agriculture, the major farm organizations, and nearly all trade associations of middlemen engaged in the sale of farm products were still unsatisfied. They saw possible interference with trucks that might haul agricultural commodities immediately after (and not before) being leased to authorized carriers for the transportation of non-exempt commodities.[10]

The ICC Objective

The basic objective of the ICC in regulation of for-hire trucking is to foster a class of contract carriers operating over specified routes at regular rates and to exercise careful control over their operation. In an extract of his report on January 30, 1935, Eastman had argued that unrestricted railroad competition did not aid but harmed the public and this was also true of highway transportation. The transportation system must be dealt with as a unit, he said "for all the agencies interlock and react in a multitude of ways, that proper regulation is necessary and that self regulation by code may be useful, but cannot alone meet the public need."[11] So long as part of the transportation industry is regulated, he argued, the existence of an unregulated part competing with the regulated part is bound to produce difficulties.

Eastman further declared in this extract that:[12]

> In the regulation of trucking and shipping special and difficult problems are met which are not found in railroad regulation. There are many private and contract operators. The chief reason for regulating these is to protect the common carriers against cutthroat competition. The bills recommended undertake to confine regulation to this purpose.

This statement remains as a fair description of the policy that the ICC has favored since that time. The philosophy that common carriers—who

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[9] Proposed section 207.4(a)(3)(i), Code of Federal Regulations.

[10] Testimony of Earl W. Love before the Interstate Commerce Commission testifying on Ex parte No. MC43, May 17, 1954. He was representing the Secretary of Agriculture.

[11] Quoted in *Traffic World,* Vol. LV, p. 194. This was an extract released by Eastman of the longer *Report of Federal Coordinator of Transportation, 1934,* released January 30, 1935, House Document 89, 74th Congress, 2d Session. This document and the earlier report by the Federal Coordinator of Transportation, *Regulation of Transportation Agencies,* released March 10, 1934, Senate Document 152, 73d Congress, 2d Session, are well worth examination. The description of truck transportation, as it existed throughout the trucking industry, could be applied with little change to exempt transportation today.

[12] *Ibid.*

by the terms of their certificates are obligated to transport for the general public at published rates under specified conditions—should be protected has had wide acceptance.

The Motor Carrier Act, 1935, clearly specifies that for-hire transportation of all but exempt commodities requires authorization by the ICC. Where regular service is offered to the general public at published rates, a certificate to perform as a common carrier must be obtained. Where transportation is performed for hire and under contract to one or more shippers, a permit to act as a contract carrier must be obtained. Business concerns that have set up separate transportation divisions have discovered that the ICC may demand that these divisions obtain contract carrier permits before they can legally perform transportation service for the rest of the company.[13]

Questionable Leasing Techniques

The ICC objects to the close similarity that trip-leasing independents often bear to contract carriers. The similarity is often quite marked. For example, an independent will often solicit business independently and then go to a carrier who holds an ICC authorization, sign a technical lease of his equipment to that carrier, and complete the transportation in the guise of an employee of the authorized carrier. Paper labels pasted on the side of the truck serve to identify it as equipment leased by the authorized carrier whose actual function may be no more than to demand a percentage of the revenue for the privilege of using his authorization.

How this type of operation proceeds was illustrated concisely and lucidly at the Senate committee hearings by an opponent of the bill who presented the following extracts from an ICC hearing:[14]

Exhibit B

Queenie Capazolli Application, Heard at Pittsburgh, Pa, November 16, 1953, MC-112450, Sub. No. 1

Record, page 8:

Q: Now will you tell the examiner just what services you are performing?
A: Hauling butter from Fairmont Foods to Boston, Worchester, and New York under a trip-lease arrangement with Atlantic Freight Lines and Liberty Motor Freight Lines.
Q: How long has your trip lease been in existence with Atlantic Freight Lines hauling butter?
A: It was made for one trip but I have been hauling it since March 31, 1949.

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[13] See, for example, Schenley Distillers Corp. *vs.* U. S.; 326 U. S. 432 (1946).

[14] U. S. Congress. Subcommittee of the Senate Committee on Interstate and Foreign Commerce. *Amendment to Interstate Commerce Act (Trip Leasing).* Hearings, 83d Congress, 2d Session, on House Resolution 3203. (Part 2) Washington, p. 200.

Record, page 11:

Q: You, yourself, hold no interstate commerce authority; do you?
A: I do not.
Q: When you haul these shipments eastbound to these New England States and to New York, what do you bring back?
A: Exempt-products commodities, you know, produce for these brokers.

Record, page 12:

Q: Now, Mr. Capazolli, does the Atlantic Freight Lines tell you when to spot your trailer at Fairmont Foods?
A: No, sir.
Q: Who does?
A: I do.
Q: You do what?
A: I call them up and tell them there is a load of butter going, and I go and pick up my leases and go and pick up the load and deliver it.

Record, page 13:

Q: But who notifies you that the butter is available?
A: Fairmont Foods.

Record, page 20:

Q: Do you know whether or not Liberty Motor Freight Lines has the right to serve Pittsburgh?
A: They seem to be; they are leasing me.
Q: (By the Examiner) Answer the question.
A: I don't dig into their rights. They advertise service into the New England States.
Q: Your answer is "No"—you don't know?
A: I don't know.

Record, page 21:

Q: Is it a fact that you do not communicate with them any time whenever Fairmont calls you for a load?
A: Communicate with whom?
Q: You do not talk to Liberty at all?
A: Only when the load goes. I call Liberty and tell them there is a load going to Boston.
Q: Is it a fact that Fairmont calls you and not Liberty; is that not right?
A: That is correct.
Q: Is it a fact that Fairmont calls you and not Atlantic Freight Lines?
A: That is correct.

Record, page 22:

Q: Except for payment to Liberty and Atlantic Freight Lines, do you take care of all the rest of the details in connection with the handling of these shipments?
A: I do.

Record, page 31:

Q: When you lease to the Atlantic and Liberty, how do you arrange to be paid? Do you get so much per mile?

A: No; 75 percent of the revenue.
Examiner. You get the full revenue on the exempt commodities?
A: The brokers only take out 10 percent. Some take out 7 percent. They don't chop it like those freight lines.
Q: Who pays the turnpike charges?
A: I do.

The extent to which the freight lines "chop it" (take a percentage) is an indication of the economic value of a company's ability to extend coverage to a trucker who has no authorization.

A thin line separates the bona fide lease of trucks and the operation by the lessor as a contract hauler. Those who engage in the latter practices designed to circumvent ICC control (the ICC reports that it knows of 77 different types) are able to manipulate their paperwork carefully so as to stay on the right side of the law.[15] Even clearly illegal practices appear to be common and relatively safe partly as a result of the undermanning of the ICC's enforcement staff. It is evident also that the exemption has played a major role in keeping the industrial organization of motor trucking from developing, after 1935, into the form the ICC visualized as being in the national interest, and that was clearly spelled out in Eastman's reports. The ICC's attitude toward the exemption and trip lease has been to treat them as undesirable variances from a general philosophy of regulation that it and the more established carriers favor, and that is the basis of most transportation law.

Whether or not the ICC has hit upon the appropriate remedy is questionable. The Commission's actions may be hard to reconcile with a concept of public policy oriented toward efficiency in resource utilization. Grange representative Halvorson's statement, "it is to me amazing that the ICC gives certificates to trucking companies for loads in one direction and nothing to return," carries an important suggestion that the ICC, by its practices in granting authorizations, which present to carriers the alternatives of trip leasing or returning empty, had made large-scale trip leasing almost inevitable.[16]

[15] In a brief presented in the hearings on Ex parte No. MC43, the ICC Bureau of Motor Carriers listed 77 "objectionable practices" of which the above are examples. Some truck operators testified at the hearings that they had heard of all the practices mentioned and a few others besides. The basis for objection seems to have been that the practices interfered with the control which the ICC desired to exercise over competition in trucking and which it contemplated that the Motor Carrier Act, 1935, should permit.

[16] 83d Congress, *op. cit.*, p. 467. Only after the recent court cases of ICC *vs.* Service Trucking Company and ICC *vs.* Dunn have authorized carriers been permitted to haul exempt commodities on backhauls at less than authorized rates or over other than authorized routes. Previously, few authorized carriers could operate successfully in the movement of the exempt commodities. Today they are showing a renewed interest in produce movement, but their eventual role remains in doubt.

Attorney Neil Brooks, representing the Secretary of Agriculture before the Supreme Court, stated:[17]

> . . . to avoid economic waste and inefficiency in the marketing of agricultural products by motor truck carrier, the prevailing practice is for haulers of agricultural commodities to trip lease their motor trucks to regulated carriers so as to avoid the necessity of making return trips empty.
>
> If the Commission's rules are made effective so that the leasing of motor vehicles by authorized carriers is restricted to a period of at least 30 days, there can be no doubt that the rules will have a disruptive effect on the hauling of agricultural commodities.

Members of the ICC staff have indicated that some rates might be increased and a less efficient utilization of equipment result from establishment of the proposed regulation on trip leasing. An ICC examiner held that a schedule of rates for fresh meat hauled by a contract carrier between Louisville, Kentucky, and New York-Pennsylvania points was unjustifiably low since the rates would not be compensatory unless the return of empty equipment was held to a minimum. The examiner held that, since trip leasing would soon be banned [sic] and no other arrangements were indicated for lease or use of equipment, it must be presumed that most equipment would be returned empty.[18]

Probable Impact of Proposals

To claim that the institution of the trip-lease proposal would precipitate a crisis in agricultural truck transportation is putting it too strongly. The proposal has many loopholes. Not all agricultural truckers would be affected since some do not regularly depend on trip leasing. The modification introduced after the original proposal was made, designed to permit a trucker who had just completed an exempt haul to trip lease toward the point where the exempt haul originated or toward his headquarters, so greatly enlarged the possibilities of trip leasing under the proposal that it might have no real regulatory effect at all. Additional flexibility

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[17] The Supreme Court has ruled the ICC's proposed remedy to be within its power to decree. The opinion, delivered by Justice Reed, stated: ". . . all admit, of course, that the rules do not directly apply to agricultural equipment; it is merely required that authorized carriers using such trucks comply with certain provisions. But it is contended that the pre-conditions to such use imposed on those within the Commission's jurisdiction will wipe out much of the traffic which the agricultural carriers have heretofore engaged in . . . the mere fact that the commercial carriers of agricultural products will hereafter be required to establish their charges on the basis of an empty return trip is not the same as bringing them within Commission jurisdiction generally." See U. S. Supreme Court Reports, 97 Lawyers Ed., American Trucking Associations, Eastern Motor Express and Secretary of Agriculture *vs.* ICC, pp. 337-367.

[18] Interstate Commerce Commission, I and SM 4269, Fresh Meats, Louisville, Kentucky, to New York and Pennsylvania.

could be accomplished by judicious location of headquarters. Private concerns, such as meat packers, often haul exempt commodities on backhauls after taking their own goods to markets or, less commonly, as the backhaul on trips to secure supplies. They would not be affected. As the proposed ban applies only to trucks leased with drivers, there is no limitation placed on lease of equipment when the person who leases the truck provides his own driver.

Finally, it is questionable that the ban, even if fully effective, would be a curse. Although a regulated trucking industry has not been favored by agricultural interests, regulation has often worked to the advantage of shippers. Fruit and vegetable middlemen interviewed in a recent study pointed out many advantages in using railroads. To a large extent, these advantages were by-products of regulation or of the obligations inherent in the status of common carrier.

One factor must be added. By the rulings in the Kablin case,[19] the courts have considerably expanded the scope of the exemption. If, as appears possible, frozen foods and meat are added to the exempt list, the need for trip leasing will be reduced since these products are among the most important backhauls of perishable exempt commodities. Under the present understanding of the exemption, trip leasing is necessary for transportation of frozen foods and meat by truck drivers who have no ICC authorization.

Perspective on Trip Lease

Present transportation policy has been widely considered unsatisfactory for a number of years now, and what to do about the agricultural exemptions is only a part—though an important part—of the over-all problem. It is clear that a solution should be sought consistent with maximum general public welfare, and determination by political infighting is not particularly likely to lead to a satisfactory result.

While trip lease is a clear case, transportation policy needs revision; it is also only a symptom of what many hold to be a more general sickness. More and more frequently, students of transportation policy have been pointing out the need for major revisions in transportation policy.[20] The

[19] ICC *vs.* Kablin, 8th Circuit Court, 1954. The court ruled that dressed poultry, previously considered to be a processed and therefore nonexempt commodity, was an exempt commodity.

[20] To quote one of the earlier pronouncements, "It may also be noted that after the nation tried and rejected the NRA codes of fair competition as a general solution for industry's price and production problems, it has continued and even elaborated a roughly comparable pattern of control in the transport field. No doubt special conditions exist which explain this development, but its variance from general economic policy for industry invites a reexamination of key but controversial features of our

question of what policy would be most beneficial from the standpoint of the general welfare and from the standpoint of agriculture is clearly not settled. There appears to be some case for special treatment of seasonal, perishable commodities. There is also a case for regulation. The question of the appropriate balance between these two cases is, in the opinion of the writer, an important one worthy of much more attention than it has yet received.

That no positive solution to the trip-lease controversy can be given suggests the need for basic research in transportation policy. Many of the problems of policy important in the early days—adequacy of transportation in the rural areas and discriminatory rates, for example—are no longer major problems. On the other hand, the impact of transportation rates on interregional competition and costs of agricultural marketing is today of great importance. Unfortunately, agricultural transportation experts often seem to be absorbed in preparing partisan arguments for hearings on rates and regulations.[21]

The great enigmas of the trip-lease controversy concern the location and magnitude of the benefits and costs. The lines on which the exemption was drawn were primarily political. The claim that conditions of agricultural markets put unusual burdens of flexibility upon the trucking industry, and justify the kind of industry that can exist only with an exemption, is interesting; but railroads—quite inflexible in many respects—have continued to serve agriculture to an extent that indicates they meet agriculture's needs reasonably well. Many commodities are considered exempt for which the flexibility argument has no merit at all; and others, such as dressed meat, which could claim exemption on this basis, have not been exempt. These internal inconsistencies indicate a need for revision of policy.

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present regulatory structure." James C. Nelson, *Transportation and National Policy.* U. S. National Resources Planning Board, Washington, Govt. Print. Off., 1942, p. 197.

See *Issues Involved in a Unified and Coordinated Federal Policy for Transportation.* A report to the President from Secretary of Commerce Sawyer, December 1, 1949.

See, also, Transportation Association of America. *Sound Transportation for the National Welfare,* Chicago, 1953; pp. 64-69. The exemptions are of special interest. interest.

[21] Much work also has been directly concerned with efficiency of transportation where this is likely to reduce costs of agricultural marketing. Considerable work has been done under the Research and Marketing Act on physical developments and new or better use of equipment. Interest in the impact of legal restrictions that impede interstate trade in agricultural products has been responsible for several important and well-known monographs. Among the most noteworthy are George R. Taylor, E. L. Burtis, and F. V. Waugh. *Barriers to Internal Trade in Farm Products.* U. S. Bureau of Agricultural Economics, Washington, Govt. Print. Off., 1939, and Margaret R. Purcell, *Interstate Barriers to Truck Transportation.* U. S. Bureau of Agricultural Economics, 1950. Mimeographed.

If the exemption were to be found on further study to transfer income to agriculture from other parts of the economy, the soundness of that transfer should be determined, and also some decision should be made regarding the allocation of the transferred income. Use of the exemption is very unevenly distributed among commercial farmers, and noncommercial agriculture benefits very little indeed. The exemption has not been a flexible tool of policy that can be manipulated to benefit those groups particularly in need.

Under current circumstances, one wonders how long the truck transportation industry can continue to exist "half slave and half free." All appearances suggest it can go on this way indefinitely. The present policy is not sound, since there is not sufficient difference between the problems of transporting agricultural commodities and those of transporting other commodities to justify the differences in policy. Clearly one of the present policies must be more suitable than the other; or perhaps some single, modified policy may be more suitable than either. Is it possible that trip leasing and the exemption have been a kind of safety valve, which has made the present style of regulation of nonexempt commodities tolerable? This is clearly not the ICC's point of view or the trip-lease proposal would never have been made.

THE ELASTICITY OF DEMAND FOR RAILROAD TRANSPORTATION OF FLORIDA PRODUCE

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THE effect of railroad rates on the volume of rail traffic has been an important question for a long time. In support of their many petitions for higher rates, railroads have typically claimed that higher rates would have little effect on their traffic volume. On the other hand, shippers have generally claimed that higher rates would result in sharp reductions in rail traffic volume, especially because of losses to competing modes of transportation. Typically, few facts are advanced to bolster either set of claims.

The purpose of this study is to present facts that would help to answer this question. The method used was to analyze the relationships between (1) rail and truck rates in 1952, and (2) each carrier's share of the traffic in that year at important markets for each of a number of commodities.[1]

The analysis attempted to determine (1) the closeness of correlation between rail-truck rate differences and each carrier's share of the traffic, (2) the elasticity of demand for rail transportation, and (3) the optimum level of railroad rates, taking into account both the elasticity of demand and transportation costs.

Qualifications of the Data

The statistics of rates and movements were judged to be sufficiently accurate for the purpose of determining these relationships, although there were some deficiencies.

First, the figures representing truck costs are the truck rates quoted by exempt truckers or by brokers representing such truckers. The truck rates actually paid may differ somewhat from those quoted, but in the

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* The views expressed in this article are solely those of the author.

[1] The commodities analyzed were fresh fruits and vegetables shipped in relatively large volume from Florida: oranges, grapefruit, snap beans, cabbage, celery, green corn, potatoes, and tomatoes. The markets are all those for which both rail and truck unload statistics were available and to which the total movement of Florida produce was substantial. They number 12 and are: Atlanta, Baltimore, Boston, Chicago, Cleveland, Dallas, Detroit, New Orleans, New York City, Philadelphia, St. Louis, and Washington, D.C. The shipping points in Florida from which rates are quoted are Sanford (for oranges and grapefruit), Hastings (for potatoes), and Belle Glade (for all the other commodities listed). The sources of the statistics are as follows: Rail rates—published tariffs; truck rates—rate sheets issued by haulers exempt from most regulations of the Interstate Commerce Commission (because they haul only unmanufactured agricultural products) and by truck brokers; unloads—Market News Service of the U.S. Department of Agriculture.

opinion of shippers and receivers of Florida produce these differences apparently are not very large.

Second, the analysis is based to a certain extent on rates of for-hire trucks and the volume of movement by both for-hire and private trucks.[2] The assumption was made, however, that generally for-hire truck rates would not be very different from the costs of operating private trucks. In certain situations, especially in short hauls, the costs for private truckers might be less than for commercial truckers. Such situations would include cases where the grower or receiver does his own driving, as is sometimes done by small scale operators. Another example would be in an especially favorable back-haul situation for a private operation.

A third factor somewhat reducing the comparability of rates and volumes in both rail and truck shipments is that rate data apply to specific origins in Florida while the data on volume of unloads relate to the entire state. Rates on vegatables other than potatoes, for example, are from Belle Glade, in the southern part of Florida, since the available truck rates were quoted from that point. Belle Glade is an important shipping point, but others are located hundreds of miles northward and closer to the markets analyzed. Comparisons from a number of representative points would be preferred although the resulting analyses might not be appreciably more valid.

Correlation Between Rate Differences and the Division of Traffic

The following table presents coefficients of correlation (r), coefficients of determination (r^2), and regression equations for the excess of rail over truck charges in cents per 100 pounds including whatever refrigeration charges are necessary, and the rail shipments as a percentage of the total unloads at each market. These figures show the extent to which markets with low rail charges receive higher proportions of their unloads by rail.[3]

The correlation coefficients for the 8 commodities analyzed range from −.89 for celery to −.51 for potatoes. Other high coefficients were −.84 for oranges and −.82 for cabbage. The other coefficients range between −.68

[2] Although the predominant proportion of the longer-haul truck movement is in for-hire trucks, a substantial proportion of the shorter-haul movement is in privately-owned trucks. About 40 percent of the truck movement in the 1949-50 and 1950-51 seasons of Florida citrus to Atlanta was in privately-owned trucks, the remainder in for-hire trucks. This figure is based upon Marvin A. Brooker, Donald E. Church, and Kenneth M. Gilbraith, *Transportation of Fresh Citrus from Florida, Seasons 1949-50 and 1950-51*, Statistical Findings, University of Florida, Agricultural Experiment Station, August 1952.

[3] The correlation coefficients measure to what extent rail-truck rate differences affect the division of the current volume of traffic at important markets. No attempt is made to take into account the effect of rates in changing the total volume of traffic.

TABLE 1. MEASURES OF THE RELATIONSHIPS BETWEEN RAIL UNLOADS AS PERCENT OF TOTAL UNLOADS AND EXCESS OF RAIL RATES OVER TRUCK RATES, 1952

[Fresh fruits and vegetables from Florida to major southern and eastern markets]*

Commodity	Coefficient of—		Regression equation[1]	Standard error of estimate	Elasticity of demand for rail transportation[2]
	Correlation (1)	Determination (2)	(3)	(4)	(5)
	r	r^2	Y=	Sy	
Oranges	−.84	.71	81.85−1.67X	16.45	1.9
Grapefruit	−.68	.46	77.74−1.73X	25.82	2.2
Snap beans	−.75	.56	55.11−1.34X	16.93	2.8
Cabbage	−.82	.67	−9.86−2.20X	19.35	3.3
Celery	−.89	.79	41.91−2.01X	16.28	3.6
Corn, green	−.69	.48	65.68−1.25X	22.40	2.5
Potatoes	−.51	.26	95.16−2.22X	27.22	2.8
Tomatoes	−.77	.59	48.63−1.49X	20.04	2.7

* As far west as Chicago and St. Louis.

[1] Y is the rail percentage of total unloads. X is the excess of rail over truck charges, including necessary refrigeration in cents per 100 pounds.

[2] Change in the rail percentage of total unloads accompanying a change of one percent in rail rates obtained by application of the regression equations in column 3. A one-percent change in rail rates was computed on the basis of the 1952 average rate to all markets analyzed. It is assumed that truck rates would not be changed in response to changes in rail rates. Consequently, changes in cents per 100 pounds in X, the excess of rail over truck rates, would be the same as the changes in rail rates.

and −.77. The coefficient for potatoes was the only one not passing the test of statistical significance.[4]

Among the seven commodities having statistically significant coefficients of correlation, five had coefficients of determination (r^2) higher than .50, indicating that the difference between rail and truck charges explains more than half of the differences among markets in the percentage of total unloads arriving by rail. These five commodities are celery, oranges, cabbages, tomatoes, and snap beans. The coefficients of determination for green corn (.48) and grapefruit (.46) were just a little less than .50.

The correlation between (1) the difference between rail and truck charges and (2) rail as a percentage of total unloads is a close one for most of the commodities studied.

Elasticity of Demand for Railroad Freight Service

On the basis of the regression equations in table 1, the demand for railroad transportation for each of the Florida fresh fruits and vegetables analyzed has an elasticity of more than 1.0. Changes in railroad charges including refrigeration charges are estimated to result in larger

[4] The test was whether or not the coefficients differ significantly from 0, considering the size of the sample. "Significant" means the "5 percent point," i.e., that only in 5 percent (or less) of the cases, could a "significant" coefficient be obtained by chance alone from this size of sample, if the population of all markets has a correlation of 0.

percentage changes in the rail percentage of total unloads. The changes in the rail percentage of total unloads accompanying a change of 1 percent in rail rates, assuming that truck rates are not also changed, ranges from 1.9 percent for oranges to 3.6 percent for celery.

The Most Profitable Level of Railroad Rates

What is the best rate policy from the standpoint of the railroads?[5] The elasticity of demand for rail freight service and the costs of transportation are the two main factors to consider. For a commodity with an elastic demand for rail service, lower rail freight rates result in both higher volumes of rail traffic and higher gross revenues. The higher volumes of traffic entail higher total railroad out-of-pocket (or variable) costs, which vary directly with the volume of traffic. For certain commodities, possibilities exist that the increases in total out-of-pocket costs would exceed the increases in gross revenues resulting from rate reductions. In cases of some other commodities gross revenues will increase more than costs.

A rate was developed in this analysis for each commodity that would yield the maximum revenue in excess of out-of-pocket costs. These rates were calculated in the following manner. First, the probable effect of a change in rail rates on the volume of rail traffic was computed, using the regression formulae developed in the analyses of major markets. The effect on gross rail revenues was obtained by multiplying the rail volume by the corresponding rates. The amount of out-of-pocket costs corresponding to the volume of traffic indicated at the various rates was subtracted from the corresponding gross revenue.[6] The "optimum" rate for

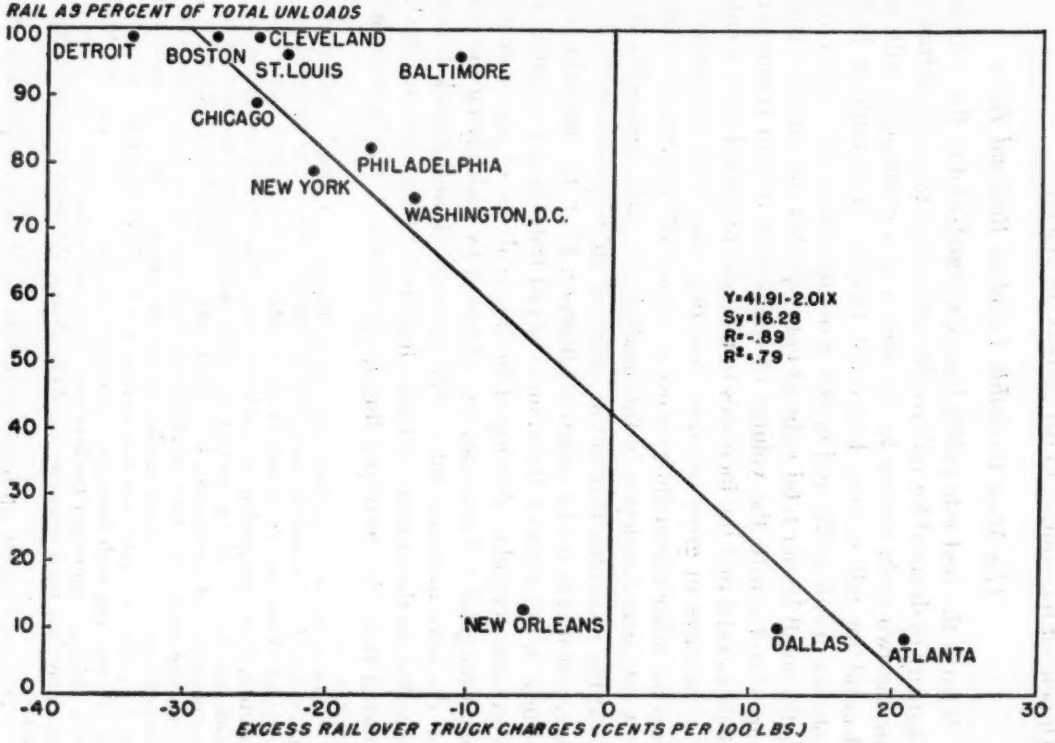
[5] This question is discussed only with respect to railroads. Rail rates are determined to a large extent by the policy of railroad officials, as qualified by regulatory standards. Costs are an important factor affecting this policy. Partly because of the relatively large proportion of overhead costs, however, consideration of "what the traffic will bear" is also important, especially with reference to the rates on individual commodities and movements, in contrast with the general level of rates.

Exempt truck rates for agricultural products are, in contrast, determined chiefly by competition among a large number of exempt carriers. Truck rates are not determined by the policy of a relatively few carriers, nor are they subject to regulatory standards. In the long run such rates are determined by the costs of operating trucks. In any case, although individual truckers can charge any rates they wish, there is little that any individual truck operator can do to change the level of rates of truck transportation.

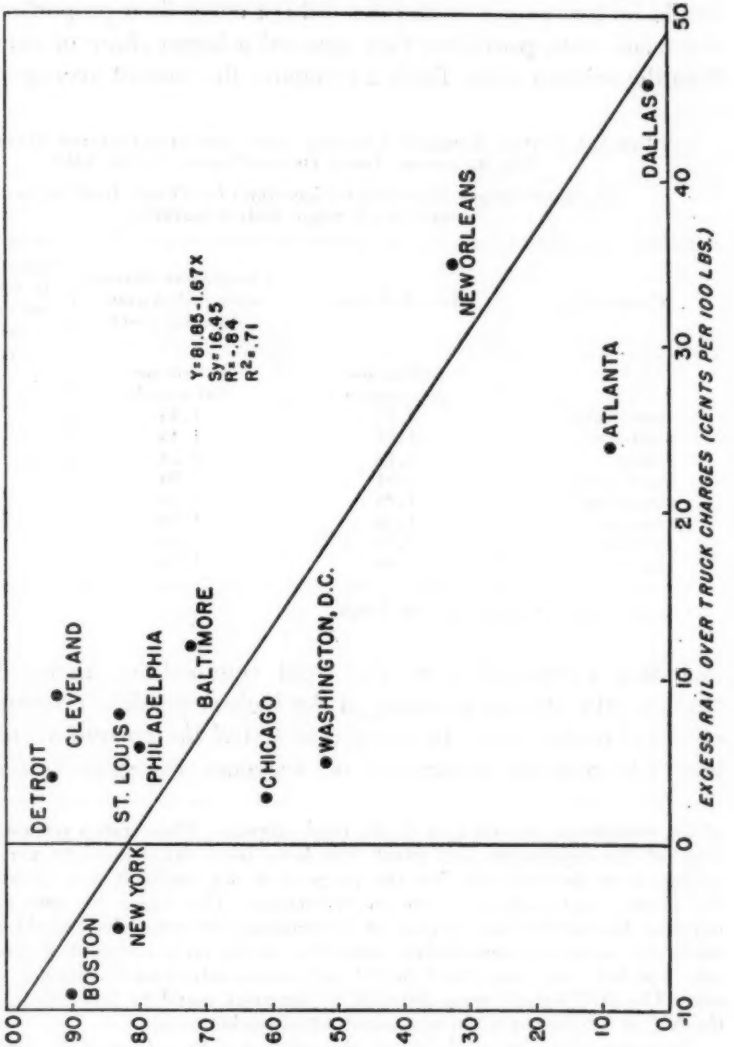
[6] The out-of-pocket rail freight costs were based upon computations of the Bureau of Accounts and Cost Finding of the Interstate Commerce Commission issued in *Rail Carload Cost Scales by Territories as of January 1, 1953*, statement No. 4-53. These costs were obtained by multiplying the ICC figures of territorial averages of terminal costs per car and line-haul costs per mile by the actual average load of each commodity and the actual length of haul in each territory, respectively. Consideration was also given to type of car, loss and damage, and other factors.

The ICC out-of-pocket costs are long run in nature. They include, in addition to 80 percent of certain operating costs, a return of 4 percent (after income taxes) on all

CORRELATION BETWEEN EXCESS OF RAIL OVER TRUCK RATES (INCLUDING REFRIGERATION CHARGES) AND RAIL UNLOADS AS PERCENT OF TOTAL UNLOADS, BY MAJOR MARKETS, 1952
FLORIDA CELERY



CORRELATION BETWEEN EXCESS OF RAIL OVER TRUCK RATES (INCLUDING REFRIGERATION CHARGES) AND RAIL UNLOADS AS PERCENT OF TOTAL UNLOADS, BY MAJOR MARKETS, 1952
FLORIDA ORANGES



each commodity was the rate yielding the maximum amount of revenue in excess of out-of-pocket costs.[7]

The optimum rates are the most profitable rates for the carriers. This would be true even if such rates did not cover their proportionate part of overhead costs, providing they covered a larger share of overhead costs than the existing rates. Table 2 compares the current average rail charges

TABLE 2. ACTUAL RAILROAD CHARGES COMPARED WITH CHARGES MAXIMIZING NET REVENUES ABOVE OUT-OF-POCKET COSTS, 1952

[Average charges (including refrigeration) for Florida fresh fruits and vegetables to major eastern markets[1]]

Commodity	Actual charges	Charges maximizing income above out-of-pocket costs	Percentage decrease in actual rates to attain maximum net income
	Dollars per 100 pounds	*Dollars per 100 pounds*	*Percent*
Beans, snap	2.12	1.95	8.0
Cabbage	1.51	1.45	4.0
Celery	1.78	1.72	3.4
Corn, green	2.01	1.99	1.0
Grapefruit	1.26	1.14	9.5
Oranges	1.16	1.09	6.0
Potatoes	1.25	1.22	2.4
Tomatoes	1.82	1.74	4.4

[1] As far west as Chicago and St. Louis.

including refrigeration on the eight commodities analyzed with the charges estimated as resulting in the highest possible revenues in excess of out-of-pocket costs. *In every case tested the current average charges had to be reduced to maximize net revenues.* For grapefruit, a reduction

of the equipment and on half of the road property. These ratios represent those portions of the equipment and plant that have been determined to vary with traffic volume over the long-run. For the purpose of this study, it was decided to deduct the figures representing return on investment. The figure for out-of-pocket costs required here is for the purpose of determining the rates that would give the railroads the maximum contribution toward a return on investment. Consequently, the out-of-pocket costs considered should not contain return on investment, as is now the case. The ICC figures were reduced by amounts equal to this return, estimated by the ICC as 12 percent of the computed out-of-pocket costs.

Estimates were also made of out-of-pocket costs for refrigeration services. Because no reliable cost data are available (no such data have been computed by the ICC or prepared by the carriers) other statistics were used. The method finally adopted was based on the actual refrigeration rates currently charged, adjusted by several factors.

[7] The formula, developed with the aid of Richard J. Foote, of the Agricultural Marketing Service, is the following: the railroad charge per 100 pounds that maximizes total income above out-of-pocket costs $= \frac{1}{2}\ (t_r - a/b + k)$ where t_r = average truck rate per 100 pounds, a and b are the constants in the regression equation, and k = average rail out-of-pocket costs per 100 pounds.

of more than 9 percent would be required, oranges a reduction of 6 percent, snap beans 8 percent, tomatoes 4 percent, potatoes 2 percent, etc.

Interpretation of Results

Several points are important in interpreting these results:

First, the comparison between actual rail rates and those that would maximize rail net incomes refers to *average* rail rates to the markets analyzed. If reductions in rates for a certain commodity would result in higher net revenues, this means that the *average* rates are to be reduced. Rates to specified markets are not imputed. The most profitable level of rates to individual markets must be determined in the light of the situation at each market, although the average situation at all markets should prove helpful as a guide.

Second, the rail charges estimated to maximize net revenues are subject to certain margins of error. This is largely due to the fact that the correlation between rail-truck rate differences and the rail share of the traffic is not perfect. The lower the correlation is the greater the errors will be in estimating rates to maximize net incomes.

TABLE 3. DATA USED IN COMPUTING RAIL RATES WHICH MAXIMIZE RAIL NET REVENUE ABOVE OUT-OF-POCKET COSTS, 1952

[Fresh fruits and vegetables from Florida to major southern and eastern markets[1]]

Commodity	Average current rail rates[2]	Average current truck rates[2]	Average out-of-pocket rail costs[2]	Regression equation	Average maximizing rail rates[2]	Percent of total unloads hauled by railroad at:	
						Current average rail and truck rates	Maximizing rail rate assuming no change in truck rate
	Dollars per 100 pounds	*Dollars per 100 pounds*	*Dollars per 100 pounds*	*Y =*	*Dollars per 100 pounds*	*Percent*	*Percent*
Beans, snap..	2.12	1.93	1.56	55.11−1.34X	1.95	28.8	52.3
Cabbage....	1.51	1.81	1.14	−9.86−2.20X	1.45	56.3	69.2
Celery.....	1.78	1.92	1.30	41.91−2.01X	1.72	70.5	88.0
Corn, green..	2.01	1.93	1.52	65.68−1.25X	1.99	55.9	58.6
Grapefruit...	1.26	1.15	0.69	77.74−1.73X	1.14	59.8	79.1
Oranges.....	1.16	1.05	0.64	81.85−1.67X	1.09	62.7	75.1
Potatoes....	1.25	1.10	0.90	95.16−2.22X	1.22	63.0	70.4
Tomatoes...	1.82	1.87	1.27	48.63−1.49X	1.74	57.3	69.2

[1] As far west as Chicago and St. Louis.

[2] Includes refrigeration charges, where necessary.

NOTE: Rates, costs and percentages of unloads are unweighted averages to major southern and eastern markets. Regression equations describe the linear relationships among these markets between the excess of rail charges over truck charges (including necessary refrigeration) in cents per 100 pounds (X), and the rail percentage of total unloads (Y).

Third, lower rail rates would result in the increases in volume of rail traffic indicated above only if truck rates are left untouched. If truck rates are reduced by the same amount, the percentages of the total volume of traffic handled by the two competing forms of transportation would presumably be the same as before any rate reductions took place. Any increases in rail tonnage would then result only from higher volumes of total traffic moving as result of the reduction in the rate level.

Although some reductions in truck rates might occur to meet rail rate cuts, such reductions probably would not be very important in the long run. Exempt truck rates are determined chiefly by competition, not only between rail and truck carriers, but also among trucks. These rates are based chiefly on trucking costs, which are overhead only to a very small extent. The Bureau of Transport Economics and Statistics of the Interstate Commerce Commission has estimated that overhead costs amount to not more than 10 percent of total motor-carrier operating costs.[8] This low figure is due to the fact that motor carrier equipment and other facilities can be quickly adapted to the volume of business done. This percentage is probably even less for exempt agricultural carriers then for the regulated motor carriers to which the ICC estimate applies. Exempt carriers generally have very little in the way of terminal facilities, which involve a large proportion of the overhead expenses of other motor carriers. Since truck costs are largely variable, rates based on such costs could not be reduced materially without causing the motor carriers to incur out-of-pocket losses.

Finally, another point that may be in question is whether or not reductions in rail rates would actually cause a diversion from trucks. Once traffic is shifted from the railroads, many shippers and receivers are likely to reorganize their operations to handle truck shipments. This would probably not be a controlling factor in the long run, although it might be important in the short run.

[8] Exhibit in Ex Parte MC-22, *Motor Carrier Costs in New England* (1944); also Statement No. 4616, *The Meaning and Significance of the Out-of-Pocket, Constant, and Joint Costs in Motor Carrier Operation* (1946).

LIVESTOCK AND GRAIN MARKET REPORTS— THEY CAN BE IMPROVED

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SOME economists believe that market information should be considered an automatic regulator of our economy. Waugh[1] has made the following statement:

"Market information is like the thermostat which regulates the heat in a house. When the house begins to get cool, the thermostat informs some gadgets on the furnace and these gadgets are supposed to turn on the heat immediately and automatically. When the supply of hogs runs a little low in some market, the market news service informs farmers and dealers and the situation is supposed to correct itself. When the price of wheat gets too high farmers are informed, and presumably will feed less wheat and plant more for next year."

Although conditions associated with World War I led directly to the inauguration of the Federal Market News Service it has been gradually expanded and improved because of the belief that it plays a great part in bringing about a more efficient allocation of resources in, and closely related to, the agricultural industry.

The purpose of this article is twofold: (1) to point out some weaknesses of the present system of reporting the livestock and grain markets and (2) to suggest some improvements that might be made in the system. Suggested improvements are generally applicable to either personnel engaged in official reporting activities for the federal government or to personnel associated with one of the media of dissemination of market information. Some may be applicable to both types of personnel.

Federal Market News Service Reports Terminal Markets

An examination of the Federal Market News Service reveals some practices that may have been more of an aid to an efficient allocation of resources in agriculture at some previous date than is true today. Each of the commodity market news services is administered in Washington and each has branch offices in outlying areas of the United States. Also, each service has market reporters located in major terminals throughout the country. Reports from these terminals are disseminated by leased wire and other means to all areas of the nation. In addition to the principal markets, information on the direct marketing of livestock is also

[1] Frederick V. Waugh, *Pricing and Trade*, U. S. Department of Agriculture, Washington, D. C. 1952, p. 23.

collected at Des Moines for the Iowa and southern Minnesota areas and at Thomasville, Georgia for the Georgia area.

The Federal Market News Service has included limited information concerned with direct marketing of livestock in its reports for a number of years. Information of this type has generally been limited to the Des Moines and Thomasville offices. (Major consideration might be given to expanding this type of service throughout the United States.) There are logical reasons warranting such consideration. The terminal markets have become of decreasing importance relative to the volume of livestock moving through the various types of markets. This implies that a proportionately greater number of livestock move through other than terminal markets than was true during World War I when the Federal Market News Service was inaugurated. In 1949 only 35 percent as many hogs and 87 percent as many cattle and calves moved through the Cleveland terminal market as in 1919. In Cincinnati only one-half as many hogs and 86 percent as many cattle and calves were serviced in 1949 as in 1919. These are examples of what has happened to the volume of livestock moving through the terminals today as compared with the World War I period. The preceding figures become more significant when account is taken of the fact that the total number of livestock marketed today is much greater than it was in 1919. What type of market is taking the place of the terminal? The answer would appear to be a number of different types, all of which have at least one common feature. This feature is one of location. Farmers are marketing more of their livestock nearer home at local markets. These include auctions, concentration yards, packer buyers, local buyers and others. Thus, on the one hand we have the terminal livestock markets becoming of decreasing importance with much attention being given to disseminating market information from these markets, and on the other hand we have the local livestock markets becoming of more importance with little attention being given to obtaining market news from this type of market.

To what extent do similar conditions exist in the grain industry? We do not suggest that grain terminals are becoming of decreasing importance. However, first handlers of grain are for the most part not located at a terminal market and local grain market information is not generally reported by the Federal Market News Service or by any other authentic source. To the extent that local markets are not generally reported for either livestock or grain there is similarity in the type of market reports available for the two products.

This suggests that technological advances in the field of market reporting have not been as great as they have been in the field of livestock marketing. In order to determine the weaknesses in market reports we

shall discuss the extent to which local livestock and local grain markets are presently reported, some of the characteristics of personnel actually reporting such markets, the extent to which farmers use market information, and the qualities of market reports farmers desire.

Present Local Reports Inadequate

Although local livestock and grain markets are not generally reported by personnel of the Federal Market News Service some local market information is disseminated through the media of television, radio, and daily newspapers. This information in many cases is not uniform among markets and often is incomplete.

Recent research in Ohio indicates that approximately one-third of the radio stations reporting livestock market news report some local information.[2] Some of the classes of livestock sales are generally not reported even though there is trading in these classes at the market for which the report is given. Often price information is given without comparable receipt quotations. Trends are usually not included in reports except when they are concerned with price quotations.

Daily newspapers usually publish the same general type of local livestock market report as is disseminated by radio stations. More than three-fourths of the papers in Ohio carrying local livestock information give quotations for only one buyer at the local level and less than five percent of the papers carry quotations for more than two buyers in the local area. In many instances newspaper reports of local livestock markets are characterized by quoting only a single price for a particular grade or weight of livestock rather than a range of prices. The single price quoted represents the top price in some reports. Actual livestock receipts for local markets are not given by most newspapers. Some papers use an adjective to describe receipts at the local level. That is, some papers give receipt information by stating that receipts are "light" or "heavy."

Local grain market reports disseminated by radio stations and daily newspapers in Ohio are similar in many respects to local livestock market reports. They are also incomplete in many instances. For example, the grade of grain for which prices are quoted was indicated on only 10 percent of the grain market news radio programs. Price and receipt trends usually are not given in either radio or newspaper reports. Also premiums and discounts because of foreign material or moisture usually are not explained or quoted.

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[2] Francis B. McCormick, *An Analysis of the Market News Service in Ohio,* Ohio Agricultural Experiment Station Research Bulletin, No. 744, Wooster, Ohio. May 1954.

Many Radio Personnel Not Qualified for Market Reporting Job

Another problem concerned with market reports disseminated by radio has to do with radio station personnel who are assigned the task of doing the actual reporting and who in some cases collect the information to report. The author believes that the radio reporter or radio station manager who assumes that the only prerequisite for reporting farm markets is the ability to read will not maintain a farm audience for any substantial period of time. Some evidence supports the premise that before farmers will listen consistently to a market reporter they must have been instilled with the idea that the reporter understands what he is reporting. Consequently, obtaining the services of a qualified market reporter is one problem faced by radio station management even when the only task of reporting consists of reading wire service copy. The problem becomes more important when local markets are to be reported and the information must be assembled by radio station personnel. Research at Ohio Agricultural Experiment Station indicates that with the exception of a few stations having a full time farm program director most Ohio radio stations employ personnel not trained in agriculture. Moreover, the rate of radio personnel turnover has been very great at many stations, possibly approaching 50 percent annually for personnel engaged in farm service work, a situation that greatly increases the need for information related to planning farm market report programs.

Farm Market Information Media Used by Farmers[3]

Most farmers obtain market information from two or three media before making a decision to sell livestock and grain. The media used and the importance of each medium, from a farmer view point, varies among the commodities being prepared for sale. Until recently the media used most often by farmers to obtain livestock market information were radio, daily newspapers, farm papers and telephone. Probably television should now be included in the list. The farmer survey conducted in Ohio indicated that of those who sell hogs approximately 80 percent obtain some type of hog market information from radio prior to the date of sale. The percent of farmers who use other media was as follows: daily newspapers 65, farm papers 48, and telephone 26. (The survey was conducted in 1950 prior to the time television became an important medium of communication.) Less than three percent of the randomly selected group of farmers indicated that they market hogs without consulting any source of market information. Although figures for other species of livestock were similar, there was some indication that slightly less consideration is given market

[3] *Ibid.*

information before sales of each are consummated. The period of time that farmers obtain market information prior to time of sale varied from a day or two before the sale date for a few farmers to a more general practice of day-to-day following of market conditions throughout the year.

Grain market information is obtained from most of the same sources as livestock information; but farmers rank the various media in a different order of importance for grain. Many make a practice of stopping at a local elevator to obtain price information from a bulletin board at the elevator. This source of information is used by approximately one-half of the farmers. Daily newspapers are the second most-used source followed by radio, telephone and farm papers. A majority of farmers follow the grain market throughout the year although the proportion who do this is somewhat less than in the case of livestock.

Type of Farm Market Information Farmers Desire[4]

A part of the Ohio study was concerned with the type of information farmers believed should comprise livestock and grain market reports disseminated by radio stations and daily newspapers. Views expressed by farmers represented their ideas of ideal livestock and grain market reports.

Farmers want market reports from both radio stations and daily newspapers. More than three-fourths of all farmers want their favorite radio station to report livestock market information, and almost as many want grain market information reported. Various minor reasons are given for not desiring such reports. The important one seems to be lack of personal interest in the respective commodities. If a farmer doesn't want a livestock or grain market report from radio the chances are fairly great that he does not often market the commodity.

Daily newspaper livestock market reports are desired by approximately two-thirds of all farmers while more than one-half are anxious to have their daily paper carry grain market quotations.

The noon hour is the popular time of day for a market report. The time of day a radio market report is scheduled is important to both radio stations and farmers. Radio stations constantly strive for a maximum number of listeners. A convenient time helps them attain this objective. Farmers want such programs scheduled at a time when it is both convenient to listen, as well as a time when maximum benefits can be obtained. In view of the importance of this problem, a number of approaches were used in the Ohio study in attempting to arrive at the most desirable time periods. The first approach involved asking farmers for their first, second, and third choices of times during the day when they would like

[4] *Ibid.*

a market broadcast. Another approach involved explaining the different aspects of market reports that could be included in a report during various times of day. A third approach involved asking farmers when they would usually listen to market broadcasts. The noon period is the most desirable time of day for scheduling broadcasts in each approach. The second most desirable time of day is from 6 A.M. until 8 A.M. while the third most desirable time is the mid-morning period between 9 A.M. and 11 A.M. A few farmers are interested in an evening broadcast.

Farmers want radio stations and daily newspapers to report local markets as well as terminal markets. The number of markets from which farmers want reports varies among individual farmers; but there appeared to be a demand warranting information from at least three markets in any report. Reasons given for selecting particular markets usually are associated with one of two ideas. The market selected may be one where the farmer markets a particular commodity; or the farmer believes market prices at his market are determined to a large extent by prices at the market from which he wants a report. Farmers logically want reports from markets where they are most likely to consummate a sale, often small markets in a local community.

Actual prices and actual receipts are desired in a livestock market report. A majority of farmers want actual figures for all markets reported as opposed to trends only for all markets, or trends only for some markets and actual figures for some markets.

Nearly all farmers want more than a top price quoted in a livestock market report. Most farmers want a range of prices for each grade of livestock, together with the most common price for the grade. A few believe a range of prices by grade is all that need be quoted while a few others believe a range by grade plus the top price for the grade should be given in any report. Less than five percent are interested only in a top price.

Trends are desired in all reports. Farmers want all types of trend information in any market report. These include livestock price and receipt trends together with grain price and receipt trends.

Farmers would like a receipts report for each grade of livestock. This type of information has usually not been made a component of livestock reports in the past. More than one-half of all farmers are interested in this information.

Farmers want a summary statement reported. A summary statement refers to a brief review of conditions at the major United States markets and may be given without mentioning any particular market by name.

Grain futures quotations are important to some farmers. This information is not understood by many farmers but approximately one-half would like it to be made a part of grain market reports.

Farmers want grain discounts explained and quoted. A common practice in the grain industry is to quote prices for a certain grade of grain and, because of either excess moisture or foreign material or less than maximum moisture or foreign material, to pay individual farmers more or less than the quoted price. Inasmuch as farmers are only interested in the price for the specified grain they have for sale, they are interested in knowing in advance the amount of discounts or premiums they will receive if their grain is other than the quoted grade.

Conclusions and Some Suggested Approaches For Improvement

A summary of the preceding pages leads to several logical conclusions. (1) The Federal Market News Service assembles and reports information relating mainly to terminal markets throughout the United States. (2) Local livestock and grain markets have become relatively more important during the past 40 years. (3) Local livestock and grain markets usually are not reported by the Federal Market News Service. (4) Personnel employed by the various media of dissemination in many instances are not qualified to assemble and report local market information. (5) Most farmers make use of one or more sources of market information before consummating a sale of livestock or grain. (6) Farmers are interested in, and desire, reports from local livestock and grain markets. (7) Market reports presently available, whether emanating from the Federal Market News Service or from a local outlet, might be revised in a number of ways to better satisfy farmers' desires and needs.

The first six of the preceding conclusions are all concerned with local markets and local market reports. Inasmuch as farmers want and need information about local market conditions, what are some of the alternative possibilities for obtaining this service?

A program to educate personnel associated with various media of dissemination. This would involve added responsibility on the part of agricultural colleges, including the Agricultural Extension Service, and the agricultural marketing agencies for working with television, radio, and newspaper personnel who report the farm markets. Personnel associated with the various media of dissemination have generally not been trained in the field of agriculture. Many personnel in this category would welcome short workshops and similar educational meetings, conducted by colleges of agriculture and/or the Agricultural Extension Service, in which major emphasis would be given to both assembling and disseminating local market information. The complete cooperation of many marketing agencies would be required. Some market agencies might welcome an opportunity to co-sponsor, with the educational institutions, schools and meetings of the type previously mentioned. Many worthwhile ideas would probably come from such schools and meetings. Any long-lasting benefits from such a

program, however, would likely be limited by the rapid turnover in personnel of radio and television stations and daily newspapers and there would always be new personnel to educate.

Encourage private agencies to report their respective local markets. A program centered around this idea would probably involve little change from the system of reporting presently in effect. Organization in a formal manner would be difficult, at best, involving an informal agreement between the marketing agencies and various media of dissemination. Each agency would agree to furnish information regarding its own market to radio and television stations and daily newspapers, and personnel in each medium would in turn agree to disseminate the information given it by a market agency. Leadership in such a program could be taken by agricultural extension marketing specialists in the respective states in cooperation with members of journalism and editorial departments. Leaders might work through market organizations in the respective states and also through state organizations. An example of this type of organization is the Radio Farm Directors. Leaders might also work with country extension personnel to secure cooperation between market agencies and those associated with radio, television, and newspaper work.

Perhaps such an informal program would not be very successful. It would lack a central coordinator and more important there would be no impartial observer reporting from the sidelines. These reasons were associated with problems leading to inauguration of the Federal Market News Service during World War I.

Give market reporting responsibilities to some existing agency. Responsibility for actually reporting local farm markets might be given to some existing agency whose main objective is not farm market reporting. Two types of agencies represent possibilities for this task, the government sponsored agencies such as the Agricultural Extension Service, and the private agencies such as the Farm Bureau, the Grange, and the Farmers Union. State leaders of any one of these or other similar organizations might take the responsibility for reporting local markets in their respective states. State leaders could in turn delegate responsibility for reporting to county personnel. County personnel would work with market agencies and media of dissemination in their respective counties. They would be charged with the responsibility of assembling information to report as well as the responsibility for the actual reporting. Possibly in some cases, radio and television personnel might do the reporting according to plans and specifications of personnel of the responsible agency.

Such a plan also would have important limitations, one of which would be inexperienced personnel at the outset of the program. Such personnel might consider these activities as a sideline and the attribute of specializa-

tion would be lacking. Having a local agency attempt such a project, however, would likely result in a much broader understanding on the part of farmers and market agencies of some of the problems involved in market reporting activities. An understanding on the part of the interested parties might eventually result in general support for federal and state supervision of this type of reporting activities. Such support has generally not been evident in the past.

Inaugurate Federal-State Market News Service at the local level. Another idea to be given consideration for reporting local markets is for the Federal Market News Service and state departments of agriculture to inaugurate reporting services at the local level. The service suggested would be of the same type as that presently given at major terminal markets.

Some will argue that the cost of this type of service would be prohibitive, and one must admit that the cost of providing for a complete market reporting staff at each local market would be too great to contemplate. There may be other less costly alternatives, however, for providing market reporting service at the local level. One possible alternative would be for the responsible government agency to assign a geographic area to a local market news office, in contrast to assigning each market news office one local market. This type of assignment might follow one of two general courses of action.

First, a local market news office in a small geographic area might be assigned the responsibility of reporting market conditions for more than one commodity. Even if the market reporting staff consisted of only one man, he could report conditions for a large number of commodities. All other conditions being equal, the size of the geographic area would depend on the number of market reporting personnel available.

Second, assign a local market news office a relatively large geographic area and give the local office responsibility for reporting conditions on one or two commodities in the area. This plan would maintain the system of commodity specialization now practiced by the Federal Market News Service. Market news personnel would move from market to market within the area. Livestock markets at the local level do not operate each day of the week. Some operate only one day per week. One market news reporter could cover a number of local livestock markets. Other commodity markets could be similarly contacted. Market news personnel would work closely with the various media of dissemination within the area as well as with the various market agencies.

Research is required to develop detailed procedure for assembling local market information and for developing effective methods of efficient dissemination. Serious consideration should be given to inaugurating a num-

ber of research projects throughout the country for the purpose of developing reporting procedure, as is possible under Title II of the Research and Marketing Act of 1946. Improved methods of market reporting must be inaugurated if local markets are to be reported effectively. Previously mentioned plans, and procedure developed as a result of research may serve as an aid in the development and adoption of improved methods.

A METHOD OF FARM REAL ESTATE VALUATION FOR TAX ASSESSMENT*

HOWARD W. OTTOSON, ANDREW R. AANDAHL, AND L. BURBANK KRISTJANSON†

INTEREST in the problems of farm land valuation is particularly high in states in which property taxes are an important part of public revenues. A source of concern is the tendency for assessed valuations to be concentrated around an average, rather than showing the variation that might be expected in view of the variation in the productivity of land and in the sale values of farms in a given area. The purpose of the study reviewed in this paper is to test procedures that might be helpful in improving the valuation of farm land for taxation purposes.

Nearly all of the states have specified market values as the legal basis for valuation of property for taxation. Therefore it is appropriate to first examine the land market from which sale values originate. Generalizations concerning the land market are not easily made because no two farms are the same. Land is not a uniform commodity; its characteristics may vary even within a small area. The fixed improvements—buildings, and others—vary considerably from one tract to another. Individual buyers emphasize different characteristics of land. Income productivity is an important factor in the minds of most buyers, except where land is needed for certain other specialized purposes. The adequacy of the farm buildings is important to the prospective buyer who is looking for a complete farming unit, but is of little importance to the buyer who is looking for additional land to add to an existing unit. Location factors are of varying importance to different buyers. Buyers differ in the extent to which they are willing to pay for proximity to school, church, relatives, shopping center, and recreational facilities. Then nationality pattern of a community is very important to some people, but of no consequence to others. Some buyers are interested in the farm as a home as well as an income producing unit; they consider attributes ranging all the way from the construction of the dwelling to the beauty of the landscape. We must recognize that some of the factors mentioned will not lend themselves to effective quantitative measurement, even though they are important. Also, the circumstances of different land sales are highly variable and therefore considerable judgment is required before generalizations are made.

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* Paper No. 643, Journal Series, Nebraska Agricultural Experiment Station. This paper has benefited from the comments of Karl Gertel, T. S. Thorfinnson, Roy P. Matelski, P. A. Henderson, and Kris Kristjanson.

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We have attempted to test the relationships between some of these factors contributing to market values of land in Saunders County, Nebraska. The analysis focuses on these relationships, particularly from the standpoint of the tax assessors, with the aim of demonstrating techniques that can be used by them in improving valuations for taxation. The analytical content of the study should be of interest to all who deal in one way or another with market value data for land.

Present Situation

The deviation between assessed values and sale values in Saunders County, Nebraska, is indicated in Figure 1. The assessed values of all

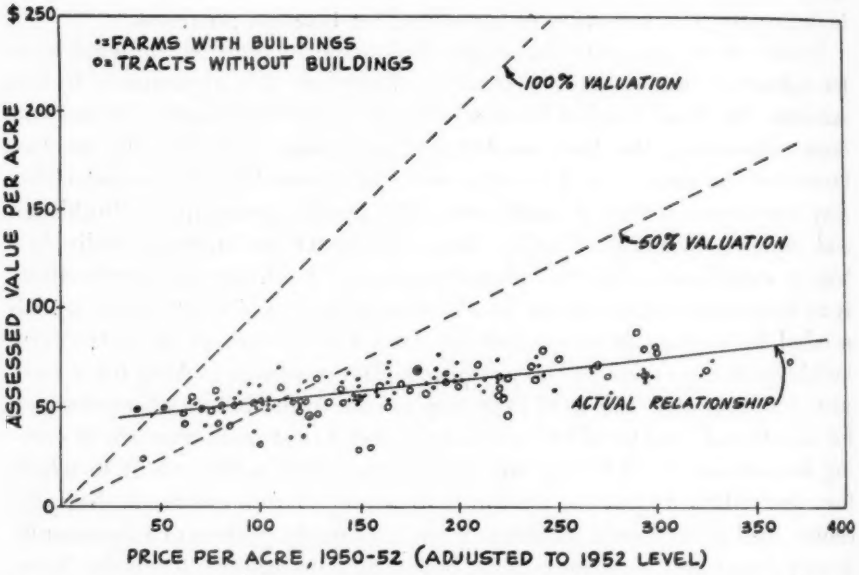

Fig. 1. Relationship Between Assessed Value and Sale Value for Farm Sales, Saunders County, Nebraska, 1950-52.

farm land sold during the years 1950-52 are plotted against the sale prices per acre. Only bona fide sales are included.[1] The sale prices for 1951 and 1952 were adusted to the 1952 level by means of indexes of real estate prices developed from sales data from the surrounding counties. For these tracts the average assessed value per acre was $60, while the average adjusted sale price was $140. Thus, the average assessment-sale ratio was 43. The correct ratio legally would have been 100 during the

[1] Excluded were intra-family transactions which were not market transfers in the ordinary sense, as well as transactions where land was purchased for non-agricultural uses. An example of the latter was the sale of a farm tract to a country club.

years enumerated. The assessment-sale ratios ranged from 22 to 159 for the three-year period.

The range in sale price is from $40 to $330 per acre, in contrast with the narrower range of $25 to $90 per acre for the assessed values. This suggests overassessment of land of lower value compared with higher priced land. The solid line represents the average relationship between assessed values and sale values for the three-year period.[2] The relationship that would have been correct legally, during the years studied, is indicated by the steeper dotted line. The relationship under the 50 per cent valuation law passed by the 1953 Legislature is represented by the lower dotted line.

Analytical Procedure

The empirical phase of this study was in two parts. First, a survey was made of 71 farms from three soil association areas of Saunders County. The farms were selected at random in each of the three soil association areas comprising a major portion of the county. Only 160-acre farms were sampled so size of farm would not influence the comparisons. The resulting data were used to test hypotheses concerning the relationships between estimated farm value and productivity, buildings, and locations, as well as the relative importance of various locational factors.

In the second phase of the study the bona fide farm sales for three years were obtained. The tracts studied number 138, including 76 with buildings and 62 without buildings. Data concerning the economic productivity, buildings and location of these sale tracts were used for further tests of the relationships studied in the first phase.

Economic Productivity

The first step was the estimation of ratings representing the average relative income productivity of the soils in each tract in both the survey group and the sales group. Soils areas as mapped by the Soil Survey, Soil Conservation Service, furnished the basic estimation units on each farm. Soil technicians, who were guided by crop yield data and input data including commercial fertilizer, manure, lime, erosion control practices, green manure, and crop combinations obtained from the sample farms by interview, as well as experimental and other data, made estimates of presently typical cropping systems and associated yields for each of the soil mapping units of the soil survey.[3] These yield estimates were used in

[2] The regression equation is $Y = 40.8 + .111X$. The regression coefficient is statistically significant at greater than the 99 per cent level of probability.

[3] The estimates were made by A. R. Aandahl and Tom Beezely of the Soil Survey, U. S. Soil Conservation Service, with the assistance of R. P. Matelski, Agronomy Department, University of Nebraska.

calculating production estimates for each soil. The net income productivity per acre was then estimated by use of selected price and cost data.[4] These estimates were converted into percentage ratings for each soil. The soils class showing the highest estimated net income was rated at 100, and other soils were rated proportionately, with zero representing no net income productivity. Pasture ratings were also estimated for those soils for which there was a question concerning which use, crop production or pasture, would be the more profitable. The higher of the two ratings was selected as the final economic rating for these soils.[5] The weighted average rating was then calculated for each survey farm and sale tract by multiplying the rating for each soil in the farm by the number of acres, summing these products, and dividing by the total number of acres in the farm.

Each operator of the survey farms was asked to estimate the sale value (1952) of his farm. These estimates were positively related to the economic ratings for soils for the sample farms; the relationship was highly significant, statistically. A similar analysis was made of the relationship between sale values and economic ratings for soils for the farms sold in 1950-52. The farms with buildings and the tracts without buildings were treated separately. The resulting regression coefficients are significant at greater than the 99 per cent level of probability.[6] Actually, the mean adjusted sale values for the farms with buildings and for tracts without buildings were almost the same, being $163 and $159 per acre respectively. The tracts without buildings were smaller, averaging 74 acres, as compared with 123 acres for farms with buildings. Competition for smaller tracts by people desiring to enlarge existing farm units apparently is one reason for the relatively high sale prices of tracts without buildings.

The data for the individual farms with buildings are shown in Figure 2. The scatter of these data is due to the valuation by buyers of other factors besides productivity, to errors by buyers in estimating economic productivity, as well as to errors introduced in the analysis itself.[7] The

[4] From "Projected Long-Term Prices, Administrative Release," Bureau of Agricultural Economics, U.S.D.A., August, 1952. The data may be representative of the next few years under the assumptions of high employment, a stable peace, and fairly high levels of economic activity.

[5] The procedure used in estimating economic ratings for various soils is discussed in more detail in Andrew R. Aandahl, William G. Murray, and Wayne Scholtes, "Economic Ratings of soils for Tax Assessment," *This Journal*, Vol. 36, No. 3, August, 1954, pp. 483-99.

[6] The regression equations are $Y = 40.7 + 2.11X$ for the tracts with buildings and $Y = 16.4 + 2.47X$ for the tracts without buildings. Y represents the sale value per acre, while X represents the economic rating for soils.

[7] The economic ratings estimated for the analysis are based on a particular set of price-cost expectations. The expectations upon which individual buyers formulate estimates of income productivity vary with their individual circumstances.

relationship furnishes a basis for making preliminary estimates of the sale values of tracts for which we know the economic ratings of soils. These estimates can then be adjusted up or down for other factors such as buildings and locations that might be important in influencing the sale values of particular farms. In the case of the tracts without buildings, this estimate might be the final one to be used as the basis for assessment in the county. Given the size and economic rating of any tract without buildings, the total sale value for 1952 could be estimated.

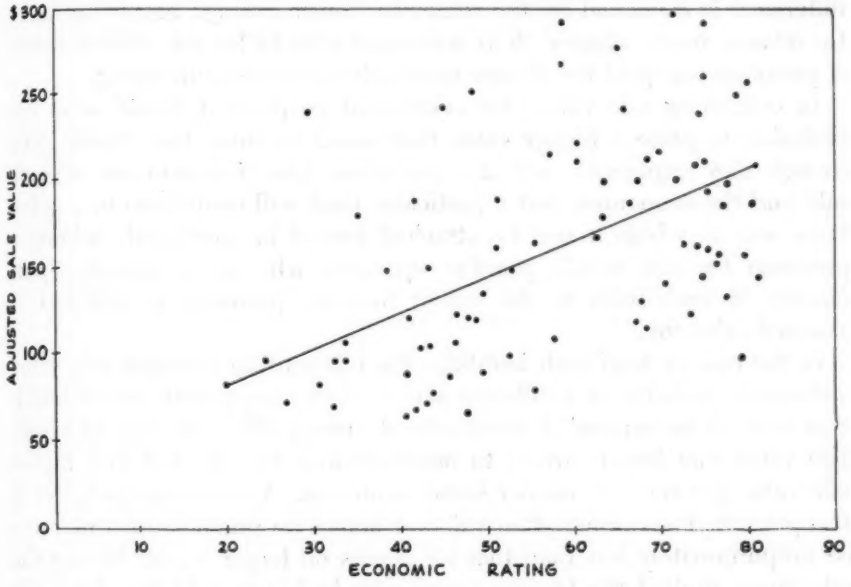

FIG. 2. RELATIONSHIP OF ADJUSTED SALE VALUE TO ECONOMIC RATING, FARMS WITH BUILDINGS.

Farmers often recognized the distinction between productivity of soils and their past management as related to land value. Each farmer in the survey was asked to choose between two hypothetical farms that had been subjected to the same management. The soils on one were better than on the other, and corn yields averaged 45 bushels per acre, compared with 35 bushels on the other farm. The respondents indicated that they would pay approximately $23 more per acre for the first farm. However, when asked to choose between two farms with the same kind of soil, but on which the differences in management inputs had resulted in the same yield differentials, they indicated a premium of only $15 per acre for the higher yielding farm.

Size of Tract

The size of tract affects the sale value of land. Small tracts without buildings furnish possibilities for economies of scale to surrounding farms. An additional 40 or 80 acres of land, when incorporated with a going farm unit, may make possible the more efficient use of machinery, labor and buildings on the existing unit. That these economies are great enough to be recognized by purchasers seems evident from some of the sale data. The 40-acre bare tracts sold for an average of $185 per acre at 1952 prices, as compared with $154 per acre for 80-acre tracts. Part of this difference is explained by the somewhat lower average economic rating for 80-acre tracts, namely 58 as compared with 64 for the 40-acre tracts. A premium was paid for 40-acre tracts with the same soils rating.

In estimating sale values for assessment purposes it would seem undesirable to place a higher value than usual on small bare tracts, even though they apparently sell at a premium. The circumstances of each sale and the economies that a particular tract will contribute to a going farm unit to which it will be attached cannot be predicted. Adding a premium for size would penalize operators who are prospective purchasers of such units to the extent that the premium is reflected in assessed valuation.

In the case of land with buildings the relationship between sale value and size is probably of a different source. As we suggested, sets of buildings tend to be somewhat standardized among different sizes of farms. The value that buyers attach to buildings may be reflected in a higher sale value per acre for smaller farms in an area. A consumption factor is also present. The consumption value of homes on smaller farms may not be proportionately less than that for homes on larger tracts. Among the sale farms studied the 80-acre farms with buildings sold for about $18 more per acre than the 160-acre farms.

The sale price per acre is significantly and inversely related to acreage in the case of both farms with buildings and tracts without buildings. The regression equations are $Y = 204.7 - .34X$ for tracts with buildings, and $Y = 195.0 - .49X$ for bare tracts, where Y represents adjusted sale value and X represents size in acres.

Farm Buildings

The survey farmers estimated the value of the buildings on their farms at about $47 per acre, or $7,520 per farm (160 acres). Valuations of such magnitude are not reflected in the sales data. The farms with buildings averaged 123 acres in size as compared with 74 acres for tracts without buildings. We noted the tendency of farmers to bid up small tracts without buildings. A more precise comparison can be made between tracts

of the same size. The 80-acre farms with buildings sold for an average of $20 more per acre than the tracts without buildings. Apparently buyers paid a premium for buildings equivalent to $1,600 per tract. The tracts in the two groups are of approximately equal economic productivity.

A visual inspection was made of the buildings on the sale farms, and ratings were estimated for them on their ability to contribute to the sale values. This analysis was of a cursory nature and would be inadequate in actual assessment procedure. Despite these limitations the analysis indicates the possibilities of including buildings in the assessment process.

Each farmhouse was rated for condition, type (age), and size. The following point system was used in estimating the ratings:

Condition		*Type (Age)*		*Size*	
Excellent	5	Ranch Type	5	Too Large	1
Good	4	Cape Cod	4	Average	2
Fair	3	Bungalow	3	Too Small	1
Poor	2	Square	2		
Falling	1	L and T	1		

The rating for the house was estimated by multiplying the scores for condition, type, and size, with a highest possible score of 50.

The farm buildings other than the house were rated as a group on the basis of condition and adequacy. The condition was scored from 5 to 1, with 5 being the highest possible score. Both age and state of repair were considered in estimating a score for condition. Sets of buildings were scored from 1 to 10 for adequacy. Multiplying the score for condition by the score for adequacy gave the estimated rating for the farm buildings, with a total possible of 50. Adding the scores for the house and the other buildings gave the total building rating, with a highest possible score of 100. The relative weighting of the house to the other buildings was consistent with the results from the survey farms. The respondents placed the house and yard in approximately equal importance to the other buildings as a factor that they would consider in buying a farm.

The linear regression equation derived for the relationship between sale values and building ratings for the farms with buildings is $Y = 119 + .96X$, where X = estimated building rating and Y = adjusted sale value. The equations for 80- and 160-acre farms are $Y = 128 + 1.17X$ and $Y = 98 + 1.05X$, respectively. Each of the regression coefficients was highly significant.

Size of tract must be considered in assessing farm buildings. To the extent that buildings represent a fixed investment between farms of various sizes, the effect of buildings on sale value per acre will be inversely related to size. Building ratings probably should be estimated

in terms of the modal size of farm. Then the adjustment of the estimated sale value for the effect of the buildings on a specific tract might be on a whole farm basis, using the modal size farm to estimate the adjustment. The most common size of farm in Saunders County is 160 acres. For this size a change of 1 in the building rating was associated with a change of $1.05 in the sale value per acre, or $168 for the farm as a whole.

Of course it must be recognized that the above relationships are derived independently of other important variables such as productivity and location; that is, they do not take into account the effect of the other variables. They are at best a rough indicator. Even so, they appear to be usable for adjusting the preliminary estimate of sale value based on economic productivity.

Location

To aid in formulating a rating system for location, the sample farmers in the survey were asked to rank in order of importance a series of eight factors to be considered in buying a farm. The list included four location factors in order of choice as follows:

Productivity of land
Adequacy of buildings
Accessibility of markets
Appearance of house and yard
Accessibility of a good high school
Accessibility of church
Accessibility of shopping facilities
Accessibility of recreational facilities

Although the location factors occupy a secondary position on the list, they cannot be ignored.

For additional insight into the importance of location, the sample farmers were asked to estimate the premium that they would pay per acre for certain locational attributes in buying a farm (Table 1). The variance

Table 1. Estimated Premiums Farmers Would Be Willing to Pay for Certain Location Factors in Three Farming Areas of Saunders County, Nebraska

Location Factor	Northwest area	West area	Todd Valley
	Premium, per acre		
Proximity to school bus line[1]	$1.50	$8.44	$4.46
Proximity to town school	1.25	6.93	7.98
Proximity to good high school	4.75	6.56	4.83
Proximity to church	2.25	4.05	2.93
Proximity to relatives	3.40	3.83	2.76

[1] Assumed for purpose of this study to be 5 miles or less.

among the responses was high. The lower level of premiums for these factors in the northwest area is probably explained by the high degree of cohesiveness of the community, as well as a lower level of income.

The study included questions concerning distances from town at which farmers preferred to live. Farmers were asked to indicate which of four locations at various distances from town they would prefer in buying a farm. They were also asked to estimate the discount per acre that they would assess to other locations in buying a farm. The alternative locations were:

At the edge of town
Two miles out
Five miles out
Eight miles out

The most common preferred location was two miles out. Enough respondents discounted this location, however, to bring the average discount to $.50 per acre. The average discount was $2.43 per acre for locations at the edge of town. Beyond two miles the additional average discount was about $1.40 per mile.

The respondents who lived on dirt roads (27 cases) indicated that they would pay a premium of about $13 per acre if their farms were located on gravel. This premium was not appreciably related to the distance traveled on dirt to reach gravel. The farmers located on gravel roads indicated an average discount of $24 per acre for their farms had they been located on a dirt road. The average premium that would be paid by farmers on gravel for being located on pavement was $2 per acre, although many persons expressed no preference for locations on pavement and three indicated a discount.

An attempt was made to design a location index that might be applied to any farm in the county. The distances to high school, shopping center, and elevator were chosen as the basis for an index.

The distances from an example farm were weighted by an importance rating attached to each location by the farmers surveyed:

Location	*Miles*		*Importance Rating*		*Miles × Importance Rating*
Shopping center	3.5	×	77	=	270
High school	12.0	×	87	=	1044
Elevator	3.5	×	100	=	350
		Total		=	1664

The sum of the importance ratings $= 77 + 87 + 100 = 264$. $\frac{1664}{264} = 6.3$

average weighted miles to the three locations.

The average weighted distance from the farm to these locations was then discounted on the basis of $.50 per acre for the first 2 miles, and $1.40 per mile per acre for each additional mile. The discount per acre for the example farm would be $.50 + (4.3 × $1.40) = $6.52, plus an additional discount of $2.00 for location on a gravel road, giving a total discount per acre of $8.52. Division of this figure by $24.70, the greatest discount for any farm in the group, resulted in a location rating of 35 for the farm. In order that the location ratings might reflect desirability of location directly, rather than inversely, this figure was subtracted from 100, giving a final rating of 65.

The regression equation derived for the relationship between sale value and location rating is $Y = 141.33 + 52X$, where Y represents sale value and X the location index. The regression coefficient is significant at the 90 per cent level of probability. The larger Y intercept and the smaller regression coefficient indicate that the location apparently influenced sale price to a lesser extent than did the buildings. No location rating was established for tracts without buildings, since the location rating would be determined by the farm unit to which the tract was attached.

An over-all adjustment of the preliminary estimate of sale value can be made in terms of a discount per acre. A change of 1 point in location rating was associated with a change of $.52 per acre in sale value. Adjustment of the estimated value of a farm for location, however, is in terms of the whole farm unit. The modal size might be used as a basis for estimating total discount for location of all farms. With a modal size of 160 acres, for instance, the adjustment might be 160 × $.52, or $83 per farm, for each point that a given farm deviates from the base location rating.

Joint Relationships

The study included an investigation of the extent of joint relationships among the several factors influencing sale values. No relationship was in evidence among the sale farms between size of tract and economic rating for soils. No relationship was discernible among the sale farms or the survey farms between the economic rating for soils and the building index. Any attempt to place productivity ratings on the farms of either group on the basis of building ratings would have been unsuccessful. Location index and economic rating for soils were not related significantly among either of the two groups of farms.

A highly significant relationship existed between building rating and size of farm in the sales group. The regression equation is $Y = 22.8 + .19X$, where Y represents building rating and X represents size in acres. The coefficient of correlation between these two variables is significant at the 95 per cent level of probability.

Estimating a Sale Value for Farm Land

The individual steps used in estimating the sale value of land can now be summarized. The relationships between sale value and economic rating for soils, building ratings, and location rating for the tracts with buildings, were tested by means of multiple regression analysis. The resulting regression equation is $Y = -12.35 + 2.088X_1 + .902X_2 + .314X_3$, where Y represents sale value; X_1, economic rating for soils; X_2, building rating; and X_3, location rating. The multiple correlation coefficient of .61 is highly significant in explaining the variance of the sale values, with an F value of 14.39. ($F_{.01} = 4.08$). The regression coefficients for economic rating for soils and building rating are highly significant, statistically, while that for location is not significant within acceptable probability limits. The sizes of the respective regression coefficients indicate the relative importance of each of the independent variables in explaining variance.

Values for the farms with buildings were computed by means of the above equation. Although the unexplained variance is rather large, the linear regression equation, $Y = .21 + 1.00X$, where Y = adjusted sale value and X = estimated sale value, is consistent. The regression passes nearly through the origin, and a change in the estimated value is associated with an equal change in the sale value. Both the regression coefficient and the correlation coefficient are highly significant.

Size of tract in acres was added as a fourth variable, X_4, in the multiple regressional analysis. The resulting equation is $Y = 18.8 + 2.002X_1 + 1.1518X_2 + .7597X_3 - 4675X_4$. The multiple correlation coefficient of .708 is again highly significant, with F = 17.86. This equation explains about 13 per cent more variance than was explained by the first three independent variables. All of the regression coefficients are highly significant. When size is included as a variable, the relative importance of the building rating and the location rating in explaining variance is enhanced. The regression coefficient of economic rating for soils was not changed by the addition of the new variable.

The sale value of tracts without buildings was also related to economic rating for soils and size of tract in a multiple regression analysis. As indicated by the multiple correlation coefficient the addition of a size as a variable did not materially increase the amount of variance explained.[8]

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[8] The regression equation is $Y = 47.51 + 2.3740X_1 - .347X_2$, where X_1 = economic rating for soils and X_2 = size of tract. The regression coefficient for size is not significant, statistically.

Estimating Sale Values for Tax Assessment

The use of the above multiple regression procedure is not recommended for use by a tax assessor in estimating the sale value of the land in a county for assessment. The procedure should not be simply a mechanical process but calls for considerable judgment as well. It would seem desirable for an assessor to make use of some sort of linear analysis, either mathematic or visual, for estimating the relationship between economic productivity for soils and sale values for the land that has been sold in the county. With such a relationship, first approximations of sale value can be made for all other tracts. These first approximations can then be adjusted upward or downward for the other valuation factors, also by the use of linear regression. The procedure is illustrated below.

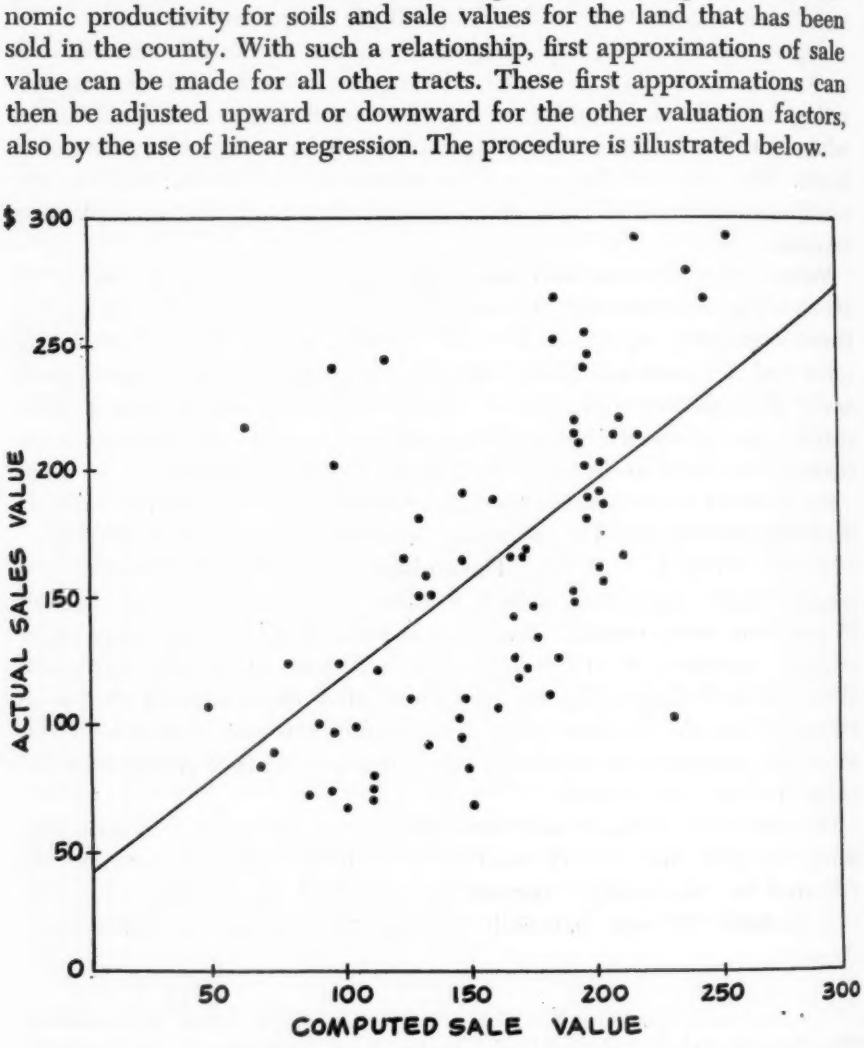

Fig. 3. Relationship Between Actual Sale Value and Computed Value, Partial Estimation Method.

Farm A, with buildings, 160 acres in size, has an economic rating for soils of 74. The preliminary estimate of sale value on the basis of productivity is $197 per acre, or $31,520 for the farm as a whole. (Estimated from Figure 2.)

The average building rating for the sale farms with buildings is 46. Farm A has a *building* rating of 30, or 16 below average. Assuming that the values of farms in this size group change $118 for each change of a point in building rating, the adjustment for buildings would be $-16 \times \$118$, or $-\$1,888$. Farm A also has a *location* rating of 65, or 23 above the average. If a change of $64 per farm is associated with a change of one point in location rating, the adjustment for location is $+23 \times \$64$, or $+\$1,472$. Thus, $\$31,520 - \$1,888 + \$1,472 = \$31,104$, the final approximation of sale value for this farm.

To check the predictive ability of this partial estimation procedure, the relationship between actual sale values and computed sale values was studied. The relationship is shown in Figure 3. The regression equation is $Y = 38.98 + .78X$, where Y is actual sale value and X is the estimated sale value. This equation is similar to that based on multiple regression analysis. The regression line passes above the origin and has less slope. Both the correlation coefficient and the regression coefficient are highly significant, statistically. The net effect of the partial estimation method, as compared with the three-variable multiple regression, is to estimate a slightly lower value per acre for farms in the range of lower sale value and a slightly higher value for farms in the range of higher sale value. Its use in estimating values for assessment appears practicable.

On first glance it would seem that the variability of the data about the regression estimate for both the multiple regression and the partial estimation procedures is too large for the method to be of practical use. Part of this variance is probably due to factors not considered in this analysis that are considered by buyers of land. A considerable part of this variance is also due to error on the part of buyers in estimating the factors considered in this analysis.

ALTERNATIVE METHODS OF FIGURING DEPRECIATION UNDER THE INTERNAL REVENUE CODE OF 1954

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A WIDELY discussed provision of the Internal Revenue Code as completely rewritten in 1954 deals with the important subject of depreciation. Farmers as well as other taxpayers face the problem of developing depreciation schedules for their newly acquired assets that come within the current provisions of law.

In the past, most farmers have used the straight-line method of depreciation because it is widely accepted, and it is relatively simple. By this method, depreciation is divided equally between the estimated number of years of useful life of the asset or group of assets.

Under the new code, taxpayers are specifically permitted to use "any reasonable and consistent method of computing depreciation" but "whatever method is adopted, due regard must be given to operating conditions during the taxable period." Among the methods mentioned in the Statutes are the straight-line, the declining-balance, and the sum-of-digits, the last 2 of which may be used for assets having a minimum useful life of 3 or more years.

The problem of the farmer or other taxpayer is to decide upon a depreciation method that is most useful for his individual business operations—keeping in mind the technical limitations as set forth in the Internal Revenue laws and regulations.

Economic Considerations

Among the economic considerations that appear to be pertinent in this determination are: possible interest savings; how to minimize income taxes if the asset is sold; probable trend of income-tax rates; and future level of prices.

The Question of Interest

The specified alternatives to the straight-line method of depreciation permit a higher charge-off in the first half of the useful life of the machinery, equipment, building, or other asset. Because of the time element, one way of looking at faster depreciation is that in effect it amounts to an interest-free loan to the taxpayer, equal to the tax savings on current returns. In other words, the cost of the asset is amortized more rapidly, thus reducing taxable income in earlier periods while increasing income in later periods. The advantage is that tax liabilities are postponed and the taxpayer enjoys the use of the money he would have paid earlier in

taxes. Presumably the method of depreciation that maximizes this interest-free loan is best for the individual taxpayer.

Savings Through Capital Gains Taxes

The declining-balance method, which is illustrated later, permits a depreciation rate of up to twice the straight-line rate during the earlier years of useful life. If the asset is sold, the gain on the sale would be greater under faster depreciation but the benefits obtained by larger earlier deductions might more than offset the tax on the additional gain which would be subject to the levy as capital gains. In effect, more rapid depreciation transfers taxable funds from the category of ordinary income to capital gains, only half of which are taxable.

Future Tax Rates and the Price Level

The advantages of faster depreciation are limited also by the trend in income-tax rates and the price level. If tax rates rise over time, the benefits are minimized and may become negative—other things equal. Conversely, if rates fall—and taxpayers in general are optimistic in this direction—the advantage is greater. Similarly, taxpayers who expect "cheaper" dollars in future may wish to pay their taxes in those dollars, and vice versa.

The following discussion is based upon the assumption that tax rates and the level of prices will remain constant during the life of the asset used in the examples.

As mentioned, the Internal Revenue Code of 1954 specifically suggests two alternatives to the straight-line method of computing depreciation. The two methods are now explained. Formulas for the computation of the depreciation charge for any year, the cumulative depreciation, and the wearing value left are also given—when the wearing value equals original cost minus salvage value (table 1).

These formulas make it unnecessary to construct a table of depreciation entries to determine the charge applicable to a particular year, or the status of the depreciation account at that time.

Sum-of-Digits Method of Depreciation

Under this method, the digits (years) from 1 to the estimated life of an asset are added to determine the denominator of a fraction that is applicable to each year. The numerator of the fraction for any year is the number assigned that year in any array arranged in reverse order. Thus, if the estimated life of an asset is 10 years, the numbers $1 + 2 + \ldots + 9 + 10$ add to 55.

TABLE 1. FORMULAS FOR COMPUTING DEPRECIATION IN ANY YEAR, CUMULATIVE DEPRECIATION, AND REMAINING WEARING VALUE, BY METHODS[1]

Method	Depreciation charge in kth year	Cumulative depreciation thru kth year	Remaining wearing value after kth year
Straight-line	W/n	kW/n	$W(1-k/n)$
Decreasing-balance	$\frac{2W}{n}(1-2/n)^{k-1}$	$W\left[1-(1-2/n)^{k}\right]$	$W(1-2/n)^{k}$
Sum-of-digits	$\frac{2W}{n(n+1)}(n-k+1)$	$\frac{kW}{n(n+1)}(2n-k+1)$	$W\left[1-\frac{k}{n(n+1)}(2n-k+1)\right]$

[1] n = Number of years of useful life.
k = Selected year ($k \leqq n$).
W = Wearing value = Cost − Scrap value.

At the end of the first year, 10/55 of the wearing value is charged to depreciation; at the end of the second year, 9/55 of it is charged off, and so on. These fractions in every case add to 1, so that the original wearing value is completely charged off over the life of the asset.

As the sum of the digits is actually the sum of an arithmetic progression, the denominator of the fractions in any case may be determined from $\frac{n\ (n+1)}{2}$ when n is the estimated number of years of useful life of the asset. In the preceding example, $\frac{10 \times (10+1)}{2} = 55$. For an asset with a useful life of 10 years, the charge to depreciation per $1 of wearing value would be 10/55 for the first year; 9/55 for the second year; and so on (table 2).

Declining-Balance Method

Under the declining-balance method, the annual depreciation per $1 of wearing value is twice the rate applicable to the wearing value under the straight-line method. It is therefore 2/n instead of 1/n. This rate is multiplied by the wearing value left at the end of the preceding year to find the depreciation that is to be charged off at the end of the current year. For example, in table 2, the depreciation for the fifth year is 0.2×0.409600, or 0.081920 per $1 of original wearing value.

As the depreciation to be charged off is always a percentage of the remaining wearing value, the original wearing value can never be entirely charged off by this method. The 1954 Revenue Code therefore provides

that anyone who uses the declining-balance method may, without obtaining special permission, change over to the straight-line method at any time—so as to be able to charge off any remaining wearing value during the estimated life of the asset.

TABLE 2. ANNUAL DEPRECIATION AND REMAINING WEARING VALUE, PER $1 OF ORIGINAL WEARING VALUE, BASED ON ASSET HAVING 10 YEARS OF USEFUL LIFE, BY YEARS AND BY METHODS

Year	Declining-balance method		Sum-of-digits method[1]	
	Depreciation[2]	Wearing value left	Depreciation	Wearing value left
(1)	(2)	(3)	(4)	(5)
	Dollars	*Dollars*	*Dollars*	*Dollars*
1	0.200000	0.800000	0.181818[3]	0.818182
2	.160000	.640000	.163636[4]	.654546
3	.128000	.512000	.145455	.509091
4	.102400	.409600	.127273	.381818
5	.081920	.327680	.109091	.272727
6	.065536	.262144	.090909	.181818
7	.052429	.209715	.072727	.109091
8	.041943	.167772	.054545	.054546
9	.033554	.134218	.036364	.018182
10	.026844	.107374	.018182	.000000
Total	.892626	XX	1.000000	XX

[1] Sum of digits $= \frac{n(n+1)}{2}$. In example, $1+2+\cdots+9+10=55$, which may also be derived as $\frac{10(10+1)}{2}$.

[2] 2/n. In example, the constant percentage is 2/10 or 0.2. Figures in column (2) are 0.2×wearing value left at end of preceding year, as shown in column (3).

[3] 10/55×$1.

[4] 9/55×$1.

Cumulative Depreciation Charged Off

The cumulative depreciations charged off per $1 of wearing value by the time one-half and three-fourths of the useful life of an asset have passed are shown, for the declining-balance and sum-of-digits methods, in table 3, by length of life of the asset.

When half the life of an asset that has a life span of 6 or more years has passed, a higher proportion of the total depreciation has been charged off under the sum-of-digits method than under the declining-balance method. For assets with a life span of 3 to 5 years, the reverse is true.

When three-fourths of the life of an asset has expired, more of the

TABLE 8. CUMULATIVE DEPRECIATION CHARGED OFF ON ASSETS AFTER ONE-HALF AND THREE-FOURTHS OF USEFUL LIFE HAVE EXPIRED, PER $1 OF WEARING VALUE, BY LENGTH OF LIFE AND BY METHODS

Length of life	When half useful life over		When three-fourths useful life over	
	Declining-balance[1]	Sum-of-digits[2]	Declining-balance[3]	Sum-of-digits[4]
Years	*Dollars*	*Dollars*	*Dollars*	*Dollars*
3	0.8075	0.6875	0.9156	0.8906
4	.7500	.7000	.8750	.9000
5	.7211	.7083	.8527	.9063
6	.7037	.7143	.8387	.9107
7	.6920	.7188	.8291	.9141
8	.6836	.7222	.8220	.9167
10	.6723	.7273	.8124	.9204
12	.6651	.7308	.8062	.9231
15	.6581	.7344	.8000	.9258
20	.6513	.7381	.7941	.9286
25	.6473	.7404	.7906	.9303
30	.6447	.7419	.7882	.9315
35	.6429	.7431	.7866	.9323
40	.6415	.7439	.7854	.9329

[1] $1-(1-2/n)^{.5n}$.

[2] $\frac{3n+2}{4(n+1)}$.

[3] $1-(1-2/n)^{.75n}$.

[4] $\frac{0.75}{n+1}(1.25n+1)$.

total depreciation has been charged off under the sum-of-digits method than under the declining-balance method. This is true for all assets having a longer life than 3 years.

A Suggested Procedure for Changing from Declining-balance to Straight-line Method

This part of the discussion deals with a logical time when the change-over from (1) the declining-balance method to (2) the straight-line method might be made. It will be assumed that it is desirable for the annual depreciation charge to continue under method (2) at about the same figure applicable for the last year under method (1).

Setting (a) the depreciation charge for the kth year under method (1) equal to (b) the then remaining wearing value, divided by the remaining time, and solving for k in terms of n, we have . . .

$$2/n\ (1-2/n)^{k-1} = \frac{(1-2/n)^k}{n-k} \qquad \text{(See table 1.)}$$

Multiplying both sides by $(1 - 2/n)^{-k+1}$ gives an easy solution. We find that $k = 0.5(n + 2)$. For n even, k is a whole number. But for n odd, k is a mixed number, the fraction always being 1/2. Therefore, the annual depreciation charge for the kth year of life of an asset that has a useful life which consists of an odd number of years can never be exactly equal to the depreciation charge after the changeover to the straight-line method.

Table 4 shows the wearing value left at the end of k years of depreciation by the declining-balance method. This remainder is then apportioned over the remaining (n-k) years by the straight-line method. It will be

TABLE 4. CHANGING FROM DECLINING-BALANCE METHOD TO STRAIGHT-LINE METHOD OF FIGURING DEPRECIATION[1]

Life of asset	Declining-balance Method			Straight-line Method	
	Elapsed years[2]	Depreciation for kth year[3]	Wearing-value left at end of kth year[4]	Remaining life of asset	Annual depreciation for remaining life of asset
n	k			(n−k)	(4) ÷ (5)
(1)	(2)	(3)	(4)	(5)	(6)
Years	*Years*	*Dollars*	*Dollars*	*Years*	*Dollars*
4	3	0.125000	0.125000	1	0.125000
5	3	.144000	.216000	2	.108000
6	4	.098765	.197531	2	.098765
7	4	.104123	.260309	3	.086770
8	5	.079102	.237304	3	.079102
10	6	.065536	.262144	4	.065536
12	7	.055816	.279081	5	.055816
15	8	.048967	.318285	7	.045469
20	11	.034868	.313810	9	.034868
25	13	.029413	.338253	12	.028188
30	16	.023684	.331580	14	.023684
35	18	.021016	.346757	17	.020398
40	21	.017924	.340562	19	.017924

[1] Based on original wearing value (cost−scrap value) of $1.
[2] n even: $k=0.5\ (n+2)$.
n odd: $k=0.5\ (n+1)$.
[3] $2/n(1-2/n)^{k-1}$.
[4] $(1-2/n)^k$.

noted that for n even, k is 0.5 (n + 2). The depreciation charge for the kth year under the declining-balance method is exactly the same as the depreciation for each remaining year under the straight-line method. Therefore, when n is even the depreciation charge declines to a certain level and remains there for the remaining time. For example, for $n = 10$, $k = 0.5\ (10 + 2) = 6$. The depreciation charge for the sixth year under

the declining-balance method would be 0.065536 per $1 of original wearing value. At the end of the sixth year, the wearing value left would be 0.262144. This figure divided by the remaining 4 years of life gives 0.065536 as the annual depreciation under the straight-line method. Therefore, the depreciation charge for the sixth year under the declining-balance method would be the same as for the next 4 years under the straight-line method. During the life of the asset, the depreciation charge would decline until it reached 0.065536 for the sixth year. It would remain at that figure for the next 4 years, after which time the original wearing value would have been completely charged off.

For n odd, $k = 0.5\ (n + 2)$ results in a mixed number, as mentioned before, so $k = 0.5\ (n + 1)$ has been used in the table. This means that the charge for the kth year under the declining-balance method is a little more than for the remaining $(n - k)$ years under the straight-line method. For example, when $n = 15$, $k = 0.5\ (n + 1) = 0.5\ (15 + 1) = 8$. The depreciation charge for the eighth year under the declining-balance method would be 0.048967 per $1 of original wearing value. The wearing value left at that time would be 0.318285. Dividing this figure by the 7 remaining years gives an annual depreciation charge of 0.045469 under the straight-line method. Therefore, the figure for the last (eighth) year under the declining-balance method is slightly more than the succeeding payments that are to be made under the straight-line method.

It is believed that, with other considerations omitted, a logical time to change over from the declining-balance method to the straight-line method would be . . .

When n even ..... change over after k years, where $k = 0.5\ (n + 2)$.
When n odd ..... change over after k years, where $k = 0.5\ (n + 1)$.

Interest on Remaining Wearing Value Until it is "Returned" as a Deductible Expense (for Depreciation)

In a preceding section, a procedure was suggested for changing over from the declining-balance to the straight-line method, so that the entire wearing value of an asset could be charged off during its lifetime. We now ask the question: If interest were allowed on the wearing value that is tied up until it can be returned as a depreciation deduction for income-tax purposes, which of the three methods claims the smallest amount of interest per $1 of wearing value? For two interest-rate assumptions, the total interest "lost" on assets of various lengths of life are shown, by methods, in table 5. Compound interest has been used.

A simple illustration will help to clarify the computations upon which table 5 is based. Suppose the life of an asset is 4 years. The wearing value

TABLE 5. INTEREST ON MONEY "TIED UP" IN THE WEARING VALUE OF AN ASSET BEFORE IT IS CLAIMED AS A DEDUCTIBLE EXPENSE FOR DEPRECIATION, BY METHODS, AT TWO INTEREST-RATE ASSUMPTIONS, PER $1 OF WEARING VALUE[1]

Life of asset	4 percent			8 percent		
	Straight-line	Declining-balance	Sum-of-digits	Straight-line	Declining-balance	Sum-of-digits
Years	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
3	0.082	0.059	0.068	0.169	0.119	0.139
4	.104	.077	.082	.217	.159	.170
5	.127	.095	.097	.267	.199	.202
6	.150	.114	.112	.320	.242	.236
7	.173	.133	.127	.377	.286	.271
8	.198	.153	.143	.436	.333	.308
9	.249	.194	.175	.565	.434	.386
10	.302	.236	.209	.708	.545	.470
11	.388	.304	.262	.955	.736	.611
12	.548	.431	.360	1.471	1.131	.892
25	.732	.573	.465	2.158	1.652	1.241
30	.944	.740	.584	3.078	2.346	1.681
35	1.189	.928	.717	4.317	3.273	2.237
40	1.471	1.146	.865	5.995	4.522	2.947

[1] Where n = life of asset; i = interest rate; and k = year after which changeover to straight-line method occurs in the case of the declining-balance method . . . the following formulas were used:

Straight-line $1/n[S_{\overline{n+1}|}i^{-1}]-1$

Declining-balance $2/n\left[\frac{1-(1-2/n)^k(1+i)^k}{(1+i)^{-1}-1+2/n}\right]+\left[\frac{(1-2/n)^k}{n-k}(1+i)(S_{\overline{n}|}i-S_{\overline{k}|}i)\right]-1$

Sum-of-digits $\frac{2(1+i)}{n(n+1)}\left[\frac{S_{\overline{n+1}|}i-(n+1)}{i}\right]-1$

of $1 under the straight-line method might be thought of as four quarter-dollars, one of which is returned as depreciation after 1 year; the second, after 2 years; the third, after 3 years; and the fourth is returned at the end of 4 years. All of the principal (wearing value) would be returned by the end of the fourth year, so the interest lost would be $0.104; as shown for the straight-line method under the 4-percent column opposite 4 years.[1]

In these comparisons, the time of changing over from the declining-balance to the straight-line method that was suggested in the preceding section has been used. It will be noted that, regardless of the life of an asset or the interest assumption, less interest is lost by the declining-balance and sum-of-digits methods than by the straight-line method. For

[1] The depreciation charges may be thought of as an annuity due of $0.25(s_{\overline{5}|.04} - 1)$ or $1.104, of which $1 is principal and rest is interest.

assets having a life of 3 to 5 years, less interest is lost under the declining-balance method than under the sum-of-digits method; but for assets having a life of 6 or more years, the sum-of-digits method is most advantageous from this viewpoint.

Summary

To summarize, formulas for three depreciation methods are shown (table 1) for computing (1) the depreciation charge in any year k for an asset having a useful life of n years (where $k \leqq n$), (2) the cumulative depreciation charged off through the kth period, and (3) the remaining wearing value (cost minus salvage) left at the end of the kth period, after the depreciation charge for that period has been deducted from wearing value.

Table 2 gives an example of the depreciation and wearing value left at the end of each year by the declining-balance and sum-of-digits methods. The cumulative depreciations charged off on an asset by the time one-half and three-fourths of its useful life has passed are compared (table 3) by methods and by length of asset life. By the time an asset having a life span of 6 years or more is half worn out, more of its wearing value will be charged off by the sum-of-digits method than by the declining-balance method or by the straight-line method.

As the wearing value of an asset cannot be charged off in total by the declining-balance method, a time for changing over from that method to the straight-line method is proposed. Using this procedure for the declining-balance method, the three methods are then compared with respect to the "interest" on the wearing value that is "tied up" until such time as it can be "returned" as a deductible expense for depreciation in income-tax reports. At 4 and 8 percent (and at other rates not shown), these calculations (table 5) indicate that, for an asset having a life span of 6 years or more, the interest on the remaining wearing value is less under the sum-of-digits methods than under either the declining-balance method or the straight-line method.

Thus assuming unchanging income tax rates, a constant price level, and a positive income every year, the declining-balance method saves the taxpayer the most money if the estimated life of the asset is 3 to 5 years. For assets with expected lives of 6 or more years, the sum-of-the-digits method yields the largest saving.

AN EXTENSION PHILOSOPHY FOR FARM AND HOME DEVELOPMENT WORK*

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EXTENSION workers are moving into, or at least are expected to move into, an area and method of teaching that is new and unfamiliar to many of them. The *area* is that of evaluation and economic interpretation of new information and technical developments. The *method* is the greater emphasis on personal visits and contacts with farm families.

Because of the relative unfamiliarity of many county workers with this approach, there is need for establishing a general philosophy to guide agents in their relationships with farm families in this new area with this new method. This article was written with that purpose in mind. Although the ideas here expressed are directed rather specifically to this farm and home development approach, I believe many of the considerations have implications to extension teaching in general. But I shall leave this for the reader to decide.

Meaning of the Farm and Home Development Approach

The farm and home development approach in extension is intended to achieve more satisfying living for farm families through intelligent planning for the future regarding the organization and operation of their farm and their home. Emphasis is placed on the future—on planning and looking ahead—in order to better understand the consequences or results to be expected from making various adjustments to changes affecting the farm, the home, and the family members. The farm and home development approach views the farm and the home as an integrated and interdependent economic and social unit. It is a dynamic and functioning unit. It is alive and moving. It is a going concern.

This recognition leads us to the conclusion that no single part of this rather complex unit can be regarded and treated independently from any other part. Any major decision made and action taken concerning one part of this unit has consequences, good or bad, on the other parts. Suppose we find a situation where money and other resources are rather limited, which is perhaps the most realistic assumption under which to operate.

* I appreciate the helpful suggestions of several colleagues, especially those of Ray Penn, Lee Day, and Sydney Staniforth. I am most grateful for the constructive comments of Robert Spitze, University of Tennessee, former teacher and colleague, and am deeply indebted to him and Erven Long, also former teacher and colleague at the University of Tennessee, for some of the basic ideas discussed in this article. Full responsibility for all statements appearing herein of course is mine alone.

If the parents have a certain amount of money to invest, they might choose, as one alternative use, to invest in their children in the form of education. This, it is generally agreed, will result in more productive and better adjusted citizens in the future. But if our assumption of limited money should hold true, this particular action also has consequences on all family members, the home, and the farm business. It may mean a denial of certain consumption items for the home. Or it may place certain restrictions on investments made for productive purposes. These restrictions will almost certainly result in lower productivity and lower income for the present and the near future.

On the other hand, the family may choose to use this money for the purchase of certain conveniences for the home for all family members to use and enjoy. Or still another possibility is to invest it in items of production such as farm machinery, additional livestock, fertilizers, etc. Whatever the action taken, the consequences extend over this entire farm and home unit. They are not confined to the specific area where the activity occurred. This is what we mean when we say that the farm and home is an integrated and interdependent unit.

The above example is intended as an illustration and not as an all inclusive analysis of the innumerable alternatives that exist for this family. Many alternatives may require no money outlay at all. Money is used in this example solely for facility in illustration. The question however is persistent—Who is in the best position to decide how this money will be used? The father? The mother? The entire family? The extension agent? If any one person attempts to make this decision, the assumption is made that this individual knows what is good for the family and knows also what the entire family wants and desires. But the wishes and desires of the entire family are involved! It would seem, therefore, that the final decision must be made by the entire family, giving the wishes and interests of all members proper recognition. (This assumes, of course, that children participating in this decision making are mature enough to recognize and understand the significance of the problem at hand.)

Objectives and Means

We return now to the question originally posed. What do we mean by the farm and home development approach?

The approach involves a systematic thinking through, on the part of the members of the farm family, just what they want and what they can accomplish. A family's objectives may of course change as new alternatives present themselves. Just a very few years ago people did not value television very highly simply because it was not a realistic alternative. The booming TV industry and the aerials on the housetops today are sufficient evidence that this is no longer the case.

For farm families to intelligently think through what they want to accomplish, that is to say what they consider important, they will need to be familiar with a great variety of possible choices open to them. Our job as extension workers, as teachers, is to acquaint them with as many realistic and achievable alternatives as they can effectively evaluate. This makes decision making more complex for farm families, but it creates the potential for fuller and more satisfying living. A greater variety of realistic alternatives is one of the chief distinguishing characteristics of a people with a high standard of living.

In order to determine alternative courses of action that are realistic and achievable, the family must make a rather systematic and complete appraisal of their resources. They must consider such things as the quality, quantity, and potential capacity of the land, the condition and capacity of the buildings to house various kinds and amounts of feed and livestock, the condition and capacity of the machinery and equipment, presently or potentially available markets, the quantity and quality of the managerial and labor resources available, and the amount and the cost of credit or other financial resources available for expansion and development. This step then involves the family and the extension worker in visualizing the various possibilities or alternatives existing within the limitations set by the family's resources.

Appraisal of Results

A second step is to help families identify and understand the results to be expected from acting upon the various possibilities recognized. This is a difficult job but also a most essential one. If wise choices are to be made by the family regarding the possibilities previously outlined, the family *must* understand what the probable results will be in terms of income and/or satisfactions to be achieved.

For example, it would seem insufficient to inform a farm family that they can apply 100, 200, 400, 500, or some other number of pounds of fertilizer to their corn land. The family must know the results, normally to be expected, if wise decisions are to be made possible. Neither would it seem sufficient to inform people of the results to be expected from one particular level of application without pointing out the possible results to be expected from other levels. If our previous assumption of limited money should hold true, then this becomes increasingly important. If they use their limited capital to meet the specifications or recommendations concerning one aspect of their farm or home, the losses resulting from neglect of other aspects of the farm and home may well offset the advantages gained.

This example of fertilizer application is used solely for purposes of illustrating the kind of information needed by farm families if wise choices

and actions are to be taken. This same approach would seem to apply to other problems regarding the successful development and operation of the farm and home; such as the kind and number of livestock to keep, the size of farm to operate, the kind of rations and levels of feeding, the types of machinery and equipment to have, various ways and means of operating the household, methods used in rearing the children—to spank or not to spank—etc. In all areas of major decisions there are many alternatives among which to choose. And *the difference that it makes* as a result of choosing one course of action over another is *exactly* what farm families must understand if they are to choose wisely.

We must recognize, of course, that these two steps of pointing out alternatives and the results to be expected will not and cannot be approached in as formal a manner as indicated in this presentation. It is not a matter of listing first all the possible alternatives and second the various consequences to expect from choosing and acting upon certain of these possibilities. These two steps are in practice inseparable. One cannot very well talk about or appraise a recognized alternative without at the same time giving some thought to the consequences, good or bad, to be expected. But the important consideration, I believe, is to establish some principles to guide us in our work and relationships with these farm families. My conviction is that the two steps outlined provide such a guide.

We all understand, too, that it is impossible to point out *all* the possible alternatives or the various combinations of possibilities that exist. Nor is it possible to trace through all the conceivable consequences to be expected of acting in various ways. Our knowledge about the outcome of future actions is less than perfect. To draw the lines too finely and to attempt to pin-point the expected results too precisely is both unwarranted and unnecessary. So it becomes a matter of choosing and selecting among the most relevant and significant choices and consequences to be brought to the attention of farm families.

Furthermore, farm families vary a great deal as to background, knowledge, and resources presently under their control. A farmer who has been doing an excellent job of milk production for a number of years has demonstrated his knowledge of alternatives and will probably continue to make better choices than a farmer who has been doing a poor job. The first farmer, therefore, may need little more than being kept up to date on the newest developments in that field. But to approach the other farmer with this same information may seem to him so far removed from what he presently understands and thinks about that he finds it impossible to bridge that wide gap. We gain confidence in the new by being able to relate it to something we have already experienced and with which we

have some familiarity. A man 75 years ago would have been skeptical indeed to step from his horse and buggy into a modern airliner to cruise at 400 miles per hour. But today we have experienced various means of rapid transportation and are not a bit reluctant to incorporate these advances into our thinking.

This illustration undoubtedly defines the two extreme situations. Perhaps most families that we will be working with will be somewhere in between. But it does seem to point out the necessity of retaining some flexibility on our part in working with these families. I think it points up, too, the opportunities of making real progress with these families if we can alter the approach to best fit their individual needs.

Making the Decisions

The third step in trying to define the farm and home development approach is the making of the final choice, the decision itself. If we, as extension workers, *as teachers,* have done a good job in pointing out the possibilities and the results to be expected from acting on various possibilities, the family should be in a position to make a wise decision. Whether or not they make the choice that *we* would make is not nearly as important as their understanding of the results to be expected from the various courses of action open to them. The final choice must rest with the family. The choices that the family finally make will largely rest on how the family values the various results to be achieved. It is both difficult and dangerous to try to tell people what they should want. Satisfaction has no unit of measurement. It is unique for every individual. This perhaps accounts for some of the loneliness of being human. We cannot experience things *exactly* as someone else has experienced them. Therefore, our job regarding this third step is simply to make sure that we have done a good job in the first two steps.

In brief review, this farm and home development approach views the farm and the home as an integrated and interdependent economic and social unit. This approach has the education of farm families as its basic objective so that the family may make wiser and more satisfying decisions regarding the organization and operation of their farms, their homes, and their lives. We have assumed that this could be accomplished best by acquainting farm people with the alternatives open to them and getting them to understand the results to be expected from various courses of action they might follow.

This is a big job—much broader in scope than the orientation of any single department at the College. It cuts across all traditional departmental lines as established at our academic institutions. It includes the entire range of problems involved in working and living on the farm. It

will require the cooperation of all of us if we are to do the job most effectively.

How Are the Decisions Made?

As we have already indicated, the objective is to help families in making wiser and more satisfying decisions. Let us see what is involved in decision making. The decisions that families arrive at and the actions taken will depend primarily on the following three points:

1. The number of alternatives recognized by the family. If they are not aware of existing educational facilities, for example, the alternative of investing in their childrens' education simply does not exist for them. Consequently, it does not enter into their consideration.

2. The adequacy and accuracy of their information regarding the outcome or consequences of deciding and acting upon these various alternatives. For example, they may know that they can purchase commercial fertilizer but fail to understand the results, the consequences, of using it on their crops.

3. The appraisal and evaluation that they place on the results or consequences that they do understand. The family may recognize an alternative and understand the consequences of acting upon this alternative, but they may not desire these consequences. Or perhaps more accurately, they desire these results less than they do some others which can be achieved also. In other words, it is a matter of the relative weight or values placed upon various results to be achieved. Some will place greater emphasis on net income, some on labor saving, still others on satisfactions other than income, etc. No standard measure or criterion can be provided.

What we are really doing in making decisions is choosing among several recognized alternatives the *one* which we *think* will turn out to our greatest advantage. If we have but one course to follow, then we have no decision to make and therefore cannot possibly improve upon our present situation. If a stone lies in the path of the sickle on a mowing machine, the machine has no alternative but to cut into the stone. The machine has but one course to follow; it recognizes no alternatives; it has no decision to make. But the man operating the mowing machine has various alternatives open to him, provided that he has information concerning the location of the stone and understands the consequences of cutting into that stone. He can raise the sickle bar to avoid hitting the stone; he can stop the machine and haul the stone off the field; or he can ignore it and let the sickle cut into the stone.

And so it is with the multitude of decisions that the manager of a farm or home must make. The alternatives recognized make decision making

both necessary and possible. As farming and living become more highly developed and more complicated, more and more alternatives become available to the manager. Successful living is the result of wise decisions and wise decisions are those that pan-out as we anticipated. In selecting *one* way of doing a particular job rather than some other way, we must be able to predict (or anticipate) the outcome of doing this job in the various ways recognized. Otherwise, we have no real basis for choosing one over the other. Wise decision making, choosing the most satisfying one from several possible alternative courses of action, and predictions regarding the future outcome of these actions, are one and the same. They are inseparable.

We are often quite suspicious when we hear people talk about predictions or estimates. They do not carry the air of authority of recorded history. On the other hand, we can readily see that every time we make a decision we are involved in predicting the outcome. If we are not so involved, then we might as well have flipped a coin to determine which course to follow. Our predictions will, of course, not be completely accurate. Knowledge is never perfect. But as our knowledge grows, as we learn more about this universe in which we live and the means of controlling the forces in our environment, our ability to predict more accurately also grows. The fact that we cannot predict with the utmost precision should not lead us to the false conclusion that "therefore we cannot predict at all." That would be like saying "since I can't learn all there is to know about everything, I refuse to learn anything about something."

To make sound predictions (that is to say, wise decisions) we must have an understanding of ideas and information concerning certain important relationships. Not so many years ago, commercial fertilizers, hybrid seeds, vitamins, artificial breeding, soil conservation, pickup balers, etc., were barely heard of and not well understood. Today the general relationships between the application and results of these techniques is fairly well known. But this general knowledge is not sufficient for making wise choices. It must always be strengthened and supported by specific information.

In order to obtain the required knowledge and information concerning these and the innumerable relationships that farmers and homemakers must understand, we must depend largely on the ideas and information brought to light through experimentation and on the wise counsel of the specialists who devote their time to studying these relationships in their particular subject matter field. Life is too short and experimentation too costly for developing all of this information on our own. The progress of

our civilization can be largely attributed to the fact that communication of ideas and information makes it possible for people to benefit from the experiences and experiments of others.

What Do We Expect Farm Families to Accomplish?

In general we might expect farm families to improve their standard of living. By this I mean that farm families will develop new values and ambitions and recognize ways and means of fulfilling these newly acquired aspirations. Several accomplishments, of course, must have preceded this development.

First, families will need to recognize the role that predictions, estimates, and up to date information play in making wise decisions. They will need to learn and use certain ideas in making an analysis of their present situation. A fuller appreciation of these factors should improve their ability to make wiser decisions and consequently improve their standard of living.

Secondly, farm families will need to develop a proficiency in planning. Planning is, as has been mentioned, nothing more than a systematic thinking through of the consequences to be expected from different courses of action we might take based on the best information we can obtain. We are trying to predict and foresee these consequences without actually carrying out the actions. This is a method that allows us to make more intelligent choices when the final decisions are made.

There seems to be a real need for wise and careful planning if we are to live full and satisfying lives in this modern-day world. One of the chief reasons for this need is the time span involved between making the decision and realizing the results of this decision. Many of the decisions made today yield results, good or bad, over a long number of years in the future. Wise decisions can make those years satisfying while unwise decisions can fill them with sorrow.

Changes, both within and beyond the farmers line fences, are constantly occurring. Changes in the farm family and the labor force as a result of the family's life cycle call for careful planning ahead to meet these changes successfully. Increased alternatives resulting from rapidly changing technologies, increased family wealth, and improved knowledge make a constant planning and adjusting necessary. *With all these changes and with new possibilities arising the question "will it pay?" is not as pertinent to most farmers as the more difficult question "how much will it pay relative to some other alternative?"*

Thirdly, in making plans for their farm and home, we should hope for increased participation by the whole family. The extension worker's role is that of the educator in pointing out possibilities and helping families to

anticipate and understand the important consequences. If this planning and decision making can involve the whole family, the members will have had a real practical experience in living and working together to accomplish common purposes. They will have experienced the need and the advantages of cooperative effort, discussion and constructive thinking before final decisions are made, and the spirit of compromise which is so crucial to the democratic way of life. Community participation and effective citizenship are largely dependent upon an understanding of the democratic process of solving problems affecting groups of people. We cannot emphasize too strongly that in our democracy the relative merits of various courses of action to be taken must be discussed and debated by the people (or their elected representatives) who are affected by the results of these actions. This thinking, discussing, and planning for solutions to problems by the entire family should aid in accomplishing the goal of increased participation in the responsibilities of citizenship.

This is expecting great things, to be sure. We cannot expect immediate miraculous results. Values are slow in changing. New ideas are difficult to assimilate and old ones are hard to get rid of. But we will know that farm families, as a result of this educational program, will recognize and understand more alternatives, grasp more fully the consequences to be expected by acting upon them, and evaluate their lives and desires in a new and brighter light. We will have moved ahead!

How Can We do the Job Most Effectively?

In the preceding discussion, we have assumed that this program could be carried out most effectively by using the educational approach. Before we accept this assumption, let us inspect *our* alternatives and anticipate the consequences to be expected by carrying out this program in various ways. Three alternative approaches, as seen by this writer, are service, salesmanship, and education. What we wish to accomplish in this discussion is not a statement of detailed and specific rules of conduct, but, rather, a principle that will guide us most effectively in successfully carrying out this program.

The Service Approach

Let us first take a look at the service approach. Suppose a farmer has a sick cow. He knows that the cow is sick because she has not been eating and her milk production has been reduced substantially. There are several courses of action that this farmer might take. He might just leave things as they are and hope that the cow will get well. But this may be quite an unacceptable solution since his income is reduced by the reduced milk sales. As a second alternative, he could take numerous courses in veteri-

nary science before becoming a farmer so that he could diagnose the ills of the animal and give the proper treatment for restoring good health. This seems to be an inadequate solution since the farmer has so many problems that he cannot possibly be a specialist in all fields simply because of the time limitations. A third and probably the most reasonable solution would be to call a trained veterinarian. The veterinarian's job is to perform a service for a fee. The farmer understands this and knows that the fees paid to the veterinarian will mean less cash available for some other expenditure on the farm, in the home, or for the family. On the other hand, he also expects this payment to restore his cow's health and return her to full production and thereby increase his future income. Understanding these consequences that flow from such a decision, he calls the veterinarian, the service man, as the best means of solving his problem.

We have numerous service agencies serving farm and urban families. To mention but a few there are the SCS, FHA, and PCA employees, bankers, doctors, lawyers, carpenters, welders, electricians, plumbers, mechanics, tailors, etc. To be sure, many of these service agencies also engage in selling activities, sometimes only to the extent of informing people where and how they can be located while other times they may engage in intensive advertising so as to convince people of their superiority over competitors. Generally, their major emphasis is placed on performing services for people. Likewise, they may be engaged in a certain amount of educational work. The veterinarian may pass on certain ideas and information to the farmer that may prove useful to the farmer in analyzing and solving his future problems.

One assumption, it seems, exists in connection with all service agencies; that people recognize and understand their problems and the consequences that flow from the alternative means of solving these problems. In the service approach one assumes that all the family needs is assistance in either skilled workmanship or professional advice.

The Sales Approach

A second possibility mentioned is the sales approach. The salesman's job is to sell. Salesmanship is not a narrow or restricted category but varies all the way from the "high pressured" variety to a blend of salesmanship and service or semi-educational activities. The high pressure salesman is perhaps best depicted by the story of the milking machine salesman who sold the man with one cow a milking machine and accepted the cow for the down payment.

We, of course, are all salesmen in the sense that we are attempting to establish peoples' confidence in us according to the way we speak, act,

or dress, and the general impressions we create. Many people selling products such as groceries, gasoline, clothes, etc., are operating pretty much as people in the service category previously mentioned. Their particular goods or services may be so well established and of such a universal everyday use that they may be considered as providing a marketing service for people. However, price and product differentiation, intensive advertising, eye appealing product displays, etc. make it clear that the dominating characteristic is that of the salesman.

One very important consideration must be analyzed in connection with the sales approach. Our goals, our aspirations, the things we are trying to achieve may and most generally do conflict with each other. As a result, any action taken to achieve one specific goal may have the following consequences: (1) a specific goal may be reached, (2) it may now be impossible to reach some other specific goal that is equally desired, and (3) there may be undesirable consequences connected with achieving this specific goal that outweight the satisfaction obtained by its achievement. For example, suppose a family would like to expand their business and there is an 80 acre tract of land nearby which they could purchase. An outsider knowing that the family would like to expand their business (or perhaps a real estate agent trying to sell the 80 acre tract) may try to convince them that buying this land is what they should do and thereby achieve their goal of business expansion. Can we safely conclude that if the family buys this land they will have achieved their goal and will therefore be a more satisfied family? This will no doubt depend on the other consequences that accompany this action of purchasing the land. Various results may flow from this action that may tend to minimize the satisfactions inherent in achieving the original goal. For example: (1) The family may now find itself in a debt position that is quite risky and uncomfortable. (2) The family may have been planning to install a water system in the home but the purchase of this land (the achieving of this one goal) may make this impossible for at least five years. (3) The increased land may necessitate operating with some hired labor. This may create all sorts of problems because of the indivisibility of the labor input unit. Also, the hired man situation may involve costs in terms of social values, as imputed by the family, in surrendering its complete intimacy; etc.

The point is that the salesman tends to emphasize the obviously desirable consequences to be expected from a particular purchase without regard or with less regard to the undesirable or the ones that might be in open conflict in realizing other goals. The salesman tries to convince people as to what their goal should be, and then tries to sell them the means of achieving this goal. But even if the family can clearly state what

their goal is, it is still extremely difficult to make any sort of recommendation unless we know and understand *all* of the family's goals and aspirations *as well as the relative weights and values they place upon them.* This becomes almost an impossibility because of time limitations and because the members of the family may find it impossible to formalize their goals in a systematic manner or evaluate them as to their relative importance.

Can we actually appraise and determine what is "best" for farm families in organizing and conducting their businesses and their lives? Can we feel confident that the sales approach will serve as our best guide in working with these families in carrying out this program?

The Educational Approach

The third approach we want to analyze is that of education. The educational approach does not assume, as was the case in the service approach, that farm families presently possess the knowledge and information required to recognize, analyze, and understand their problems and therefore are in need only of assistance by skilled workmen or professional people. Nor does the educational approach assume, as did the sales approach, that a reasonably accurate determination of the family's needs and wishes can be made and all that is needed is to sell a family the appropriate means of achieving these wishes or goals. The educational approach does assume that no one is better equipped to make decisions, given the proper understanding of relevant ideas and information, than the people most closely and directly affected by the results of those decisions. The real job of education, then is *to acquaint people with the ideas and concepts relevant to making an analysis of their problems, and to provide them with the information needed to anticipate the consequences of alternative ways of solving these problems.*

We cannot emphasize too strongly that ideas, or principles, and factual information are equally important in the educational approach. General ideas or principles enable us to focus our attention on the relevant aspects in a situation. Their function is to direct us in our observations to spot some symptoms or indicators that point to the difficulty or the problem we are trying to analyze. Ideas also serve to identify the alternatives open to us in trying to solve these problems.

If we were to choose the educational approach, we would actually be educating people to make wise decisions. That is to say, as was mentioned earlier, we would try to equip people with the ideas and information required to make more fruitful, more satisfying decisions in managing their farms, their homes, and their lives. Neither the service or sales approach can accomplish this. While either of these two approaches may help solve

certain specific problems that farm families have, neither of them prepares families for analyzing future problem situations and understanding workable alternatives as does the educational approach.

To digress from the philosophy of the educator for a moment and assume the position of the salesman, I firmly believe that the guiding principle in conducting this program should be that of the educational point of view. Service and sales work should be used with caution and *only as a means* of furthering and facilitating the job of education. As an over-all guiding principle, the educational approach fills the bill better than either of the other approaches.

TRENDS IN NUMBER OF FARMS CLASSIFIED BY SIZE

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THIS paper describes a technique for utilizing census data to indicate the magnitude and nature of the adjustments in size of farms, as measured in acres, that had occurred up to the time of the 1950 census.

The first step is to divide the country into five major regions, the minimum number required to separate unlike sections of the country. These regions require a minimum change from the census divisions. They appear to be the smallest number that will include all states and yet segregate the country into not only symmetrical but also relatively homogeneous areas with respect to historical change, acres per farm, and other important characteristics (table 1).

Most of the reported increase in total land in farms since 1880 has occurred in the Great Plains and the Western States. Part of this increase was due to the settlement of new areas, which continued until about 1920. Since that time an estimated additional 100 million acreas of Federal, State, and Indian reservation lands have been added to the reported land in farms. Most of the remaining increase—another 100 million acres—was on privately owned land. This reported increase was due more to changes in methods of controlling grazing rights and to modification of census definitions and procedures than to an extension of agriculture into new areas. A similar increase in land in farms has been reported in recent years for Florida and Georgia, but on a much smaller scale.

The second step in this analysis is to construct a long-term series of the number of farms within significant acre-size groups. This is necessary because the size classes now used have been reported only since 1935. For example, the size interval that includes 100-259 acres is divided by the census into 4 size classes centered on multiples of 40 acres, but from 1900 to 1930 it was reported in only 2 size classes. Counts of farms are not available for any subgroups within the 100-259 acre size range for the period 1900 to 1950.

Fortunately, the census reported the number of farms and total land in farms for all size groups in 1935 and in 1940. It is possible therefore, to estimate the number of farms that would have been reported within the smaller size groups now used by assuming that their average size has not changed over time. The procedure used is illustrated by the following example:

In the North in 1940 the average size of farms in the 100-139 acre group was 116.72 acres. The average size of farms in the 140-174 acre group was 157.07 acres. It was assumed that the average size of farms within

TABLE 1. NUMBER OF FARMS, LAND IN FARMS, AND AVERAGE ACREAGE PER FARM, U. S. AND REGIONS, 1880–1950[1]

Item and year	United States	East	North	South	Plains	West
	1,000 farms	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*
A. Number of farms						
1950	5,382	444	1,498	2,135	844	462
1940	6,097	534	1,673	2,358	1,021	510
1930	6,289	536	1,623	2,471	1,156	503
1920	6,448	640	1,740	2,520	1,070	478
1910	6,362	717	1,774	2,430	1,067	373
1900	5,737	733	1,804	2,104	853	243
1890	4,565	709	1,566	1,549	595	146
1880	4,009	746	1,479	1,307	394	84
	Million acres	*Million acres*	*Million acres*	*Million acres*	*Million acres*	*Million acres*
B. Land in farms						
1950	1,159	49	214	207	363	325
1940	1,061	52	215	193	345	256
1930	987	55	210	179	325	218
1920	956	63	216	198	304	173
1910	879	69	214	207	278	111
1900	839	72	211	207	255	94
1890	623	69	186	198	124	47
1880	536	74	172	192	71	26
C. Average per farm	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
1950	215	111	143	97	431	703
1940	174	97	129	82	338	501
1930	157	102	129	73	281	433
1920	148	99	124	79	285	363
1910	138	96	121	85	260	297
1900	146	98	117	98	299	386
1890	137	97	119	128	208	324
1880	134	100	116	147	182	313

[1] The regions used in this note are as follows:
East: Maryland, Delaware, and the 9 North Atlantic States.
North: Minnesota, Iowa, Missouri, and the 5 East North Central States.
Plains: The tier of 6 States from North Dakota to Texas.
West: The 11 Western States.
South: The remaining 12 States.

these size brackets did not change from 1930 to 1940. For 1930 the census reported 526,805 farms in the size range 100-174 acres, which contained 71,451,297 acres of all land in farms. With this information it is possible to set up an equation with one unknown, as follow:

Let x = the number of farms consisting of 100-139 acres in 1930.

Then 526,805 − x = the number of farms of 140-174 acres.

And $116.72x + 157.07\ (526{,}805 - x) = 71{,}451{,}297$.

Solving, x = 279,900 = the number of farms of 100-139 acres in 1930.

And 526,805 − 279,900 = 246,905 = number of farms in the 140-174 acre size group in 1930.

The same procedure could be used to calculate the number of farms of 175-179 acres within the 175-259 acre size group reported in 1930, but the possibility of error appeared to be large. Therefore, the number of farms of this size was estimated by inspection, as follows:

In 1940 the census reported 10,621 farms with 175-179 acres. In 1935 the number reported was 11,395. By assuming about 11,000 farms of this size in 1930, the total number of farms of 140-179 acres would then be 11,000 plus the 246,905 farms of 140-174 acres previously obtained, or a total of 257,905 farms. The number of farms of 180-259 acres in 1930 was obtained by subtracting 11,000 from the 218,693 farms of 175-259 acres. This estimate was 207,693.

Although it is possible by means of this procedure to estimate the number of farms that would have been reported in each of the 12 size classes now used by the census, so much detail is not needed and may even

TABLE 2. NUMBER OF FARMS, BY ACRES IN FARM, FOR THE EAST, NORTH AND SOUTH, 1900 TO 1950

Region and year	All farms	Under 10 acres	10 to 49 acres	50 to 139 acres	140 to 179 acres	180 to 259 acres	260 to 499 acres	500 and over acres
	1,000 farms	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*
East								
1950	444	52	103	167	42	43	30	7
1945	548	77	138	204	48	46	29	6
1940	534	61	135	217	48	44	25	5
1935	611	70	160	249	54	47	26	5
1930	536	43	127	238	52	46	25	5
1920	640	52	160	286	59	52	26	5
1910	717	66	184	316	61	56	28	6
1900	733	56	184	338	63	57	29	6
North								
1950	1,498	91	238	525	236	223	158	27
1945	1,595	103	269	575	245	224	154	25
1940	1,673	103	293	657	255	210	136	20
1935	1,787	110	332	721	266	213	129	17
1930	1,623	67	264	686	258	208	125	16
1920	1,740	62	303	772	267	203	117	15
1910	1,774	75	345	771	251	197	119	16
1900	1,804	64	393	784	253	182	110	17
South								
1950	2,135	212	897	686	111	104	82	43
1945	2,281	247	977	732	114	102	74	35
1940	2,358	209	1,049	770	121	105	73	31
1935	2,653	250	1,245	823	126	107	73	29
1930	2,471	147	1,251	783	110	95	63	23
1920	2,520	119	1,244	821	127	109	73	28
1910	2,430	143	1,125	775	144	123	87	34
1900	2,104	111	867	703	158	130	97	39

obscure the major changes. An effort was made to separate any size group with a decreasing number of farms from an adjacent size group for which a stable or increasing number of farms has been reported. Numbers of farms in the size groups selected for the East, North and South regions are shown in table 2.

The number of farms of more than 999 acres is shown separately for the Great Plains and the West because this size group accounts for a substantial proportion of all farms in these regions. A significant analysis of trends in the number of farms by size in the West would require a separation of counties containing most of the irrigated acreages and Indian reservations from the rest of the region (table 3).

Since 1950 the rates of change in the indexes of farm output, mechanization, farm population and employment, indicate that adjustments in agriculture to technological advance and other economic and social forces have proceeded at least as rapidly as they did in the 1940's. The extent to which these adjustments have been reflected in rates of change in the number of farms by size, as compared with previous trends in the same region or between regions, will be apparent as soon as it becomes possible to include information contained in preliminary releases from the 1954 census.

A more penetrating analysis of this adjustment can be made as soon as

TABLE 3. NUMBER OF FARMS, BY ACRES IN FARM, FOR THE PLAINS AND WEST, 1900 TO 1950

Region and year	All farms	Under 10 acres	10 to 99 acres	100 to 179 acres	180 to 259 acres	260 to 499 acres	500 to 999 acres	1,000 and over acres
	1,000 farms	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*	*1,000 farms*
Plains								
1950	844	48	210	171	96	172	93	55
1945	941	72	251	201	100	177	89	51
1940	1,021	52	309	250	105	179	82	44
1935	1,190	50	416	301	115	189	80	39
1930	1,156	32	421	290	115	183	80	35
1920	1,070	16	381	289	106	176	69	32
1910	1,067	19	372	329	103	160	61	24
1900	853	17	325	264	75	111	39	22
West								
1950	462	82	191	51	22	37	31	48
1945	494	96	203	55	22	39	32	48
1940	510	81	216	61	23	46	38	45
1935	571	90	241	72	25	57	47	40
1930	503	69	206	66	25	56	45	37
1920	478	40	180	80	27	83	42	25
1910	373	32	131	104	22	50	20	14
1900	243	20	80	70	15	31	15	12

cross-tabulations of the characteristics of farms classified by size become available. Such tabulations may then be compared with similar tabulations from the censuses of 1945 and 1950 in order to show in some detail the nature of the changes that are taking place within selected size groups of farms. For example, it seems reasonable to assume that many farms of, say, 50-139 acres are too small for efficient operation with modern equipment and therefore that their number will continue to decline. A substantial reduction in the number of low-income farms can occur through the consolidation of some of these units into larger and more productive farms or by withdrawing the land from agricultural use. But some of these small farms now return a satisfying income to their operators and more of them could do so with the application of more capital and adoption of improved practices. Other farms of this size will continue to be the residences of part-time or semi-retired farmers. Therefore, a straight-line projection of the declining number of small farms to some zero point in the future would not be realistic.

The foregoing discussion has been concerned only with the application of a technique to major regions of this country. The same methods may be applied with even more precision to states or economic areas to show comparative rates of change in numbers of farms by size.

CLASSIFICATION OF THE AGRICULTURAL POPULATION IN THE UNITED STATES*

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THE United States is one of the few of the more developed countries, without a census classification of the population dependent on agriculture. In the official statistics of the farm population of the United States, which are available annually since 1910, residence on a "farm" is the only criterion used in defining the farm population. Even under conditions of the dispersed land-settlement pattern characteristic of the United States, where farm families customarily live on their farms rather than in villages or towns, a residence classification cannot now satisfactorily identify the population dependent on agriculture. In recent decades, the growing heterogeneity of the occupational and industrial composition of the population living on farms has made this problem more pronounced. Hard surface roads, automobiles, and other modern means of transportation, along with the suburbanization trends, have meant increasing penetration of rural life by nonfarmers and a decreasing identification of many farm people with farming as the sole or primary occupation.

Census data on occupational and industrial distribution have serious limitations for classifying the population according to the economic activity on which they are dependent. The data are restricted to the working population; and the absence of information on the number and composition of the population economically dependent on agriculture, and the degree of such dependence, has been a major gap in our statistics.

The purpose of this paper is to analyze the results of a special project collating information from the 1950 Censuses of Agriculture, Population, and Housing, which shows the degree of dependence on agriculture of a sample of farm-operator families. The collation or matching study was a cooperative project carried out by the Bureau of the Census and the Department of Agriculture and the results presented are special tabulations of certain data from this project not previously published.[1] By relating information from the schedule taken in the Census of Agriculture with information on the operator's family obtained in the Censuses of Popula-

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* A revision of a paper presented at the 114th Annual Meeting of the American Statistical Association, Montreal, Canada, September 10-13, 1954.

[1] For published results of this project and a description of its design and sampling procedures, see *Farms and Farm People: Population, Income and Housing Characteristics by Economic Size of Farm*, Government Printing Office, Washington, D.C., June 1953.

tion and Housing, a more complete picture is provided of the economic activities of the farm operator and the members of his family. This permits useful classifications of the degree of the family's dependence on farming as the source of livelihood. The procedure permits approximate measurement of the size and composition of the population in the United States directly dependent on agriculture.

Three Categories of Dependence on Farming

In 1950 there were 5,341,000 farm-operator households in the United States with a population of 21,875,000. This number of persons was equal to 94 percent of the total farm population including farm laborers living on farms. Other differences in definitions between the Census of Population and the Census of Agriculture mean that the population in farm-operator households is not exactly coterminous with the farm population classified by residence. Nevertheless, the analysis presented here includes all but a small proportion of the entire farm population.

Three categories of degree of dependence on agriculture were used for classifying the farm-operator households: (1) wholly dependent on agriculture; (2) partly dependent on agriculture with agriculture as the major source of the family income, and (3) partly dependent on agriculture with nonagriculture as the major source of income. Identification and measurement of farm families in each of these three categories is necessarily approximate rather than absolute. Neither the Census of Population nor the Census of Agriculture contained questions formulated or directed toward the specific matter of identifying and measuring the population dependent on agriculture. The collation of the records for the same family from the two censuses, however, utilized data that were sufficiently related to provide reasonable and useful approximations.

The category "wholly dependent on agriculture" is restricted to farm-operator families who, during the calendar year 1949, had no off-farm work either on the part of the farm operator or any member of his family (either in agriculture or in any other occupation), and who had no income other than from their own farming operations. Only about 2 million farm operator families or 38 percent of the total census farms fell in this category in 1950. This classification is more restrictive than a dependency on agriculture criterion requires. If a family had no income from any nonfarm source, work for pay on other farms (or other agriculturally derived income) as additions to income from one's own farm should retain a family in the category of wholly dependent on agriculture. The more restrictive definition is required because the available data do not permit separation of off-farm work into farm and nonfarm components. The defi-

nition slightly understates the size of the group labeled "completely dependent on agriculture."[2]

The "partly dependent" contains two broad categories, in each of which there was income from other sources, most commonly from off-farm work by the operator and/or members of his family. If the income obtained from sources other than the family's own farming operation was greater than the gross value of sales of farm products from the operator's farm, the family was classified as partly dependent on agiculture with its major source of income as nonagricultural. The classification of agriculture as the major source was applied to the converse of the situation just described. The available data for classifying farm operator families in either of the partly dependent categories imposed certain though not serious conceptual weaknesses in the classifications and labels used. A separation of supplemental income obtained from nonagricultural sources and comparing it with the *net* income from the family's own farming operation (instead of the gross income) would have provided a more clear-cut and precise classification of families according to the major source of income.

Classification of Farm Operator Families

Table 1 shows that 65 percent of all farm families are primarily dependent on agriculture, 30 percent have their major source of income

TABLE 1. FARM-OPERATOR FAMILIES BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES AND MAJOR REGIONS, 1950

Degree of dependence on agriculture	United States	North	South	West
	(000)	(000)	(000)	(000)
All classes	5,341	2,252	2,634	455
Wholly dependent	2,031	938	953	140
Partly dependent—agriculture major source	1,444	649	664	131
Partly dependent—nonagriculture major source	1,615	540	912	163
Not classifiable	251	125	105	21
	Percent	*Percent*	*Percent*	*Percent*
All classes	100.0	100.0	100.0	100.0
Wholly dependent	38.0	41.7	36.2	30.8
Partly dependent—agriculture major source	27.1	28.8	25.2	28.9
Partly dependent—nonagriculture major source	30.2	24.0	34.6	35.7
Not classifiable	4.7	5.5	4.0	4.6

Source: Based on unpublished records of the 1950 Censuses of Population and Agriculture compiled in a matching study made cooperatively by the Bureau of the Census and the Department of Agriculture.

[2] Other information suggests that perhaps as many as 200,000 farm operators did some work for pay on other farms and whose family income was not supplemented by any nonfarm income.

from off-farm work or nonfarm sources, and about 5 percent are not classifiable because of incomplete information.

Nationally about 38 percent of the farm operators are wholly dependent on agriculture varying from about 42 percent in the North to 31 percent in the West. The figure for the South is 36 percent. The proportion of farm operators whose major source of income came from off-farm work or nonfarm sources varied from 24 percent in the North to 35 and 36 percent in the South and West.

The distribution of the total population in farm-operator households among the three categories of dependence on agriculture was almost identical with the distribution of farm-operator families, thus indicating that there was very little variation in the average size of family among farm operators in the three categories of dependence on agriculture (table 2).

TABLE 2. POPULATION IN FARM-OPERATOR HOUSEHOLDS BY COLOR AND BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES AND SOUTH, 1950

Degree of dependency on agriculture	United States			South		
	Total	White	Non-white	Total	White	Non-white
	(000)	(000)	(000)	(000)	(000)	(000)
All classes	21,875	18,886	2,989	11,419	8,524	2,895
Wholly dependent	8,091	6,723	1,368	4,086	2,747	1,339
Partly dependent—agriculture major	6,135	5,284	851	2,999	2,171	828
Partly dependent—nonagriculture major	6,738	6,074	664	3,936	3,303	633
Unclassified	911	805	106	398	303	95
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
All classes	100.0	100.0	100.0	100.0	100.0	100.0
Wholly dependent	37.0	35.6	45.8	35.8	32.2	46.2
Partly dependent—agriculture major	28.0	28.0	28.5	26.2	25.5	28.6
Partly dependent—nonagriculture major	30.8	32.2	22.2	34.5	38.7	21.9
Unclassified	4.2	4.2	3.5	3.5	3.6	3.3

Source: See table 1.

Economic Characteristics of Farms by Degree of Dependence on Agriculture

The 1950 Census of Agriculture classified farms in the United States into "commercial" and "other" farms. Within the "commercial" group, six economic size classes were distinguished in terms of size of the farm enterprise, ranging from farms with a value of sales of $25,000 or more in 1949 in Economic Class I to farms with a value of sales from $250 to

$1,200 in Economic Class VI.[3] The noncommercial or "other" farms were divided into "part-time" farms, "residential" farms and "abnormal" farms.

Commercial farms

Among the commercial farms only half of the operator families were completely dependent on agriculture (table 3). An additional 35 percent were partly dependent on agriculture as the major source of the farm operator's family income. A direct relationship existed in Economic Classes I-V between size of farm and the proportion of farm operator

TABLE 3. DEGREE OF DEPENDENCE ON AGRICULTURE OF FARM-OPERATOR FAMILIES ON FARMS OF DIFFERING ECONOMIC SIZE, UNITED STATES, 1950

Economic class	Total	Wholly dependent on agriculture	Partly dependent on agriculture		Unclassified
			Agriculture major source	Nonagriculture major source	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
All farms	100.0	38.0	27.1	30.2	4.7
Commercial	100.0	50.5	34.7	9.6	5.2
Class I and II	100.0	55.4	34.0	3.6	7.0
Class III	100.0	53.4	36.7	4.7	5.2
Class IV	100.0	49.1	36.2	10.6	4.1
Class V	100.0	41.7	32.5	21.0	4.8
Class VI	100.0	57.3	34.2	3.0	5.5
Other farms	100.0	8.0	8.6	79.8	3.6
Part time and abnormal	100.0	1.2	7.4	90.0	1.4
Residential	100.0	12.5	9.3	73.1	5.1

Source: See table 1.

families who were completely dependent on agriculture. The range of variation was from 55 percent in Classes I and II combined to 42 percent of the farm operator families in Class V farms. However, the smallest farms in the commercial category, the Class VI farms, had the highest proportion (57 percent) who were completely dependent on agriculture. Very little variation is observable among the economic size classes of commercial farms as to the proportion that have agriculture as the major though not the sole source of the family's income. Among commercial

[3] In addition to the income criteria used for Economic Class VI farms, the following additional criteria had to be met for a farm to be classified in this size class: The operator of the farm worked off the farm less than 100 days and the income of the farm operator and members of his family received from off-farm sources in 1949 was less than the value of all farm products sold. For a fuller description of the criteria for classification of farms by economic size, see the publication cited in footnote 1.

farms, only in Economic Classes IV and V was there a sizeable proportion of farm-operator families whose major source of income was nonagricultural, approximately one-fifth in Class V and one-tenth in Class IV.

Non-commercial farms

The situation for noncommercial farms, which by definition are of a part-time or residential character, is in sharp contrast with the distribution of commercial farms. Only 8 percent of the noncommercial farms are classifiable as completely dependent on agriculture, a similar percentage are partly dependent on agriculture, with agriculture as the major source of income, while 80 percent have nonagriculture as the major source of income. To see these figures in perspective it should be noted that of all of the farms in the United States 71 percent are commercial and 29 percent are noncommercial.

Net income and dependence on agriculture

The proportion who are completely dependent on agriculture is higher both at the lower and upper portions of the income distribution (table 4). Among families with less than $2,000 net income 38 percent or more were in the "completely dependent" category, while in the $10,000 and over income level 40 percent were in the same category. The percentage of farm operator families for whom nonagriculture was the major source of income rose progressively for each income level up to the $5,000 to $7,000 group where it reached 39 percent and declined for the higher income groups. About one-fourth of the families in both the lowest and highest

TABLE 4. DEGREE OF DEPENDENCE ON AGRICULTURE OF FARM-OPERATOR FAMILIES AT DIFFERENT INCOME LEVELS, UNITED STATES, 1950

Family income class[1]	Total	Wholly dependent on agriculture	Partly dependent on agriculture		Unclassified
			Agriculture major source	Nonagriculture major source	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
All farms	100.0	38.0	27.1	30.2	4.7
Under $1,000	100.0	43.9	28.4	23.2	4.5
1,000–1,999	100.0	37.6	27.2	31.5	3.7
2,000–2,999	100.0	32.5	25.6	37.9	4.0
3,000–4,999	100.0	31.0	27.9	38.3	2.8
5,000–6,999	100.0	30.9	26.0	38.5	4.6
7,000–9,999	100.0	32.9	36.1	24.9	6.1
10,000 and over	100.0	40.3	31.5	23.5	4.7

[1] Net family income from all sources.
Source: See table 1.

income categories derived the major portion of their income from nonagricultural sources.

Tenants versus owners

A study of the tenure status of the farm operator shows that a larger proportion of tenants than owners are primarily dependent on agriculture (table 5). This is true for the country as a whole as well as for each of the

TABLE 5. DEGREE OF DEPENDENCE ON AGRICULTURE OF FARM-OPERATOR FAMILIES BY TENURE, UNITED STATES, 1950

Area and tenure	Total	Primarily dependent on agriculture[1]	Primarily dependent on non-agriculture
	Percent	Percent	Percent
United States			
Total	100.0	69.5	30.5
Owners, part owners and managers	100.0	65.4	34.6
Tenants	100.0	80.8	19.2
Sharecroppers	100.0	84.4	15.6
Other tenants	100.0	79.6	20.4
North			
Total	100.0	76.5	23.5
Owners, part owners and managers	100.0	73.2	26.8
Tenants	100.0	88.9	11.1
South			
Total	100.0	64.8	35.2
Owners, part owners and managers	100.0	58.4	41.6
Tenants	100.0	76.9	23.1
Sharecroppers	100.0	84.5	15.5
Other tenants	100.0	71.8	28.2
West			
Total	100.0	62.9	37.1
Owners, part owners and managers	100.0	60.8	39.2
Tenants	100.0	78.0	22.0

[1] Includes families that are completely dependent on agriculture and those that are partly dependent with agriculture as the major source of family income.
Source: See table 1.

three major regions. Thus 81 percent of the classifiable tenants were primarily dependent on agriculture compared with 65 percent of the owners and part owners. This reflects the high proportion of owners among the small and part-time farmers who depend mainly on nonfarm sources of income.

Type of farm differences

Primary dependence on agriculture is most characteristic of farms specializing in the production of cash grain, cotton, dairy and other live-

stock (table 6). Primary dependence on nonagriculture is most characteristic of the "miscellaneous and unclassified" farms and next most characteristic of poultry farms. In both of these farm types there is a prevalence of part-time and residential farms of a general or miscellaneous nature, often with a poultry flock as the principal enterprise.

TABLE 6. DEGREE OF DEPENDENCE ON AGRICULTURE OF FARM-OPERATOR FAMILIES ON DIFFERENT TYPES OF FARMS, UNITED STATES, 1950

Type of farm	Total	Primarily dependent on agriculture[1]	Primarily dependent on non-agriculture	Unclassified
	Percent	*Percent*	*Percent*	*Percent*
Total	100.0	64.3	28.2	7.5
Field crops	100.0	78.0	14.8	7.2
Cash grain	100.0	79.7	12.9	7.4
Cotton	100.0	77.1	16.2	6.7
Other	100.0	77.7	14.8	7.5
Vegetable	100.0	64.0	33.9	2.1
Fruit and nut	100.0	62.7	27.8	9.5
Dairy	100.0	74.8	18.4	6.8
Poultry	100.0	49.7	45.1	5.2
Other livestock	100.0	70.7	21.8	7.5
General	100.0	74.7	19.1	6.2
Primarily crop	100.0	69.3	26.7	4.0
Primarily livestock	100.0	78.7	13.9	7.4
Crop and livestock	100.0	74.6	19.1	6.3
Miscellaneous and unclassified	100.0	26.2	63.6	10.2

[1] Includes families that are completely dependent on agriculture and those that are partly dependent with agriculture as the major source of family income.
Source: See table 1.

Characteristics of the Population by Degree of Dependence on Agriculture

Age-sex composition

The age-sex composition of the population is fairly similar among the three categories of farm-operator households. The households with major dependence on nonagriculture have a slightly higher proportion of people in the 20-34 age groups and somewhat lower proportions in the 50 and over age groups than the households completely dependent on agriculture. The median age was lowest for both males and females in the households partly dependent with agriculture as the major source of income, and highest for the households wholly dependent on agriculture.

White versus nonwhite

The nonwhite population in farm-operator households was more than proportionately represented among the "wholly dependent" on agricul-

ture and less than proportionately among those primarily dependent on nonagriculture (see table 2). Forty-six percent of the entire nonwhite population in farm-operator households in the South was wholly dependent on agriculture, compared with 32 percent of the white population. In contrast, only 22 percent of the nonwhite population of farm operator households in the South was primarily dependent on nonagriculture compared with 39 percent of the white population. For the United States as a whole the distribution of the nonwhite population by degree-of-dependence categories is substantially the same as for the South, since all but a small fraction of the nonwhite farm population is concentrated in the South.

Fertility ratios

Differentials in fertility ratios[4] are not marked among women in childbearing ages in the three groups classified by degree of dependence on agriculture (table 7). However, the fertility ratios were lowest for farm-

TABLE 7. NUMBER OF CHILDREN UNDER 5 PER 1,000 WOMEN AGED 15 TO 49 IN FARM-OPERATOR HOUSEHOLDS BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES AND MAJOR REGIONS, 1950[1]

Area	Total	Wholly dependent on agriculture	Partly dependent on agriculture	
			Agriculture major source	Nonagriculture major source
United States	483	502	494	451
North and West	453	466	463	419
South—Total	510	537	526	473
White	466	476	474	452
Nonwhite	642	651	663	599[2]

[1] The ratios in this table have been standardized for age of women.
[2] Based on very small sample.
Source: See table 1.

operator families that were mainly dependent on nonagricultural incomes. This was true in the several regions and for nonwhites as well as whites in the South.

Educational levels

The average educational level of farm operators was about the same among the categories of households considered (table 8). Only in the South was there a substantially higher level of educational attainment for those who were primarily dependent on nonagriculture than for those who were primarily dependent on agriculture. This difference is due mainly to the generally higher educational level of white farm operators, since

[4] Number of children under 5 years of age per 1,000 women aged 15-49 years.

TABLE 8. MEDIAN GRADE OF SCHOOL COMPLETED BY FARM OPERATORS CLASSIFIED BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES AND MAJOR REGIONS, 1950

Degree of dependence on agriculture	Total	North	South	West
		(*median grade*)		
All classes	8.3	8.6	7.2	9.2
Primarily dependent on agriculture	8.3	8.6	5.8	9.2
Primarily dependent on nonagriculture	8.3	8.7	7.6	9.1
Unclassified	8.4	8.7	7.5	10.1

Source: See table 1.

whites were more than proportionately represented among farm operators in the South dependent primarily on nonagriculture.

Gainful occupation

The participation of the population in gainful activities was lower for males and higher for females in the population primarily dependent on nonagriculture than in the other two categories (table 9). This reflects the more general phenomenon of higher labor force participation rates of females in nonagricultural acitvities.[5] The lower labor force participation of males among households with primary dependence on income other than from their own farming operations reflects the higher proportion of retired and semi-retired farm operators in this category.

Information on the occupational composition of the employed population in each of the three categories provides (1) a basis for appraising how closely these categories approach the objective of separating the population that is economically identified with agriculture from the farm population identified by a residence criterion, and also (2) a basis for determin-

TABLE 9. LABOR FORCE PARTICIPATION RATES OF POPULATION 14 YEARS OF AGE AND OVER IN FARM-OPERATOR HOUSEHOLDS CLASSIFIED BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES, 1950

Degree of dependence on agriculture		Males	Females
	Percent	*Percent*	*Percent*
All classes	52.2	83.8	16.8
Wholly dependent	51.4	85.6	12.8
Partly dependent—agriculture major source	54.9	85.6	18.3
Partly dependent—nonagriculture major source	51.2	80.2	20.6

Source: See table 1.

[5] The lower rate of participation of women in agricultural activities is due in part to the season of the year in which the Census is taken and in part to the difficulties in measurement of unpaid family workers in agriculture.

ing the occupational composition of the several categories of families residing on farms.

In the category "wholly dependent" on agriculture, all except 6 percent of the employed were engaged in agriculture as farmers or farm laborers (table 10). The "partly dependent with agriculture as the major

TABLE 10. OCCUPATIONAL DISTRIBUTION OF EMPLOYED PERSONS IN FARM-OPERATOR HOUSEHOLDS BY DEGREE OF DEPENDENCE ON AGRICULTURE, UNITED STATES, 1950

Occupation	All classes	Wholly dependent	Partly dependent	
			Agriculture major source	Non-agriculture major source
	Percent	*Percent*	*Percent*	*Percent*
Total employed	100.0	100.0	100.0	100.0
Agricultural occupations	72.8	92.5	81.0	40.4
Farmers and farm managers	53.7	69.4	58.6	29.0
Paid farm laborers	6.8	7.8	8.0	4.3
Unpaid farm laborers	12.3	15.3	14.4	7.1
Nonagricultural occupations	25.9	6.4	17.7	58.4
Professional, technical and kindred workers	2.5	.7	2.1	5.1
Managers, officials, and proprietors, except farm	2.1	.5	1.5	4.8
Clerical and kindred workers	2.5	1.0	2.0	4.8
Sales workers	1.5	.4	1.1	3.2
Craftsmen, foremen, and kindred workers	4.2	.6	2.3	10.6
Operatives and kindred workers	7.9	1.5	4.9	19.0
Private household and service workers	2.2	.8	1.8	4.2
Laborers, except farm and mine	3.0	.9	2.0	6.7
Occupations not reported	1.3	1.1	1.3	1.2

Source: See table 1.

source of income" included 18 percent who were employed in nonagricultural occupations. The "partly dependent with nonagriculture as the major source of income" had nearly 60 percent of the employed in nonagricultural occupations. These are sharp contrasts suggesting that the classifications used in this analysis achieve with reasonable adequacy an identification of the population wholly or primarily dependent upon agriculture. Although the farm-operator households as a whole had more than a fourth of the employed persons engaged in nonagricultural occupations, only 1 in 16 was so employed in the working population of the farm-operator households classified here as wholly dependent on agriculture. This group combined with those "partly dependent having agriculture as major source" constitutes a quite homogeneous population in

respect to agricultural occupations. This combined category referred to here as "primarily dependent on agriculture" has 9 out of 10 of the employed engaged in farming occupations.

Summary and Conclusions

The paper has developed an analysis of special data measuring and describing the farm operator households in the United States in terms of varying degrees of direct dependence on agriculture. (The measurement of the population indirectly dependent on agriculture is a separate and complex problem.) The data developed here help to portray the widespread importance of nonfarm sources of income to farm operator families. Less than 40 percent of these families are dependent solely on their own farming activities, and for many of these an improvement in their level of living may have to come from off-farm employment opportunities of a supplementary or alternative nature. In addition to portraying this aspect of the interdependence between agriculture and the rest of the economy, the analysis presented permits the following observations:

1. The residence classification of farm population should be supplemented by other information obtained or obtainable in census procedures to identify the population directly dependent upon strictly farming activities. The latter is not coterminous with the farm-resident population or the population in farm-operator households. The special collation of information from the 1950 Censuses of Population, Housing, and Agriculture, shows that 30 percent of the farm-operator families are primarily dependent upon nonagricultural sources for livelihood. This suggests a need for providing at least a minimum of information to identify those farm families whose principal income during the years was from nonfarm sources. Preferably income from nonfarm sources should be restricted to wages or salaries earned in nonfarm occupations and to other incomes derived from nonfarm sources. Work for wages by farm operators or members of their families on other farms would be classified as income from agriculture in addition to income from operation or renting of farms.

2. The classification of farms into "commercial" and "other" farms adopted in the 1950 Census of Agriculture accomplishes in substantial part the objective of distinguishing between farm-operator families that are wholly or largely dependent on agriculture from the farm-operator families that are primarily dependent on nonagriculture. The noncommercial farms identified through the classification of "part-time" and "residential" farms overlap to a large degree with the farm-operator families identified in the matching study as having their major source of income from nonagricultural sources. More detailed distinctions by de-

gree of dependence on agriculture would require supplementary information.

3. Another desirable objective for census procedures is to obtain information to enable classification of farm laborer families as to the major sources of income of such families during the year. This would enable a more complete identification of the total population primarily dependent on agriculture instead of only the population in farm-operator households. The necessary data were not available to permit the inclusion of farm-laborer families in the matching study of the records of the 1950 censuses.

EFFICIENCY WITHIN AMERICAN AGRICULTURE*

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SEVERAL studies have been published in which attempts were made to measure and compare resource productivity in various sectors of American agriculture. Efficient production is a major goal of economic organization at the level of the individual firm and household and in the national economy. From the standpoint of the individual firm in agriculture efficient production is expressed in terms of relative income and comparative standards of living for the farm family. To achieve uniformly high levels of efficiency, capital and labor must be used efficiently over all farming locations of the nation and resources must be used efficiently between the opportunities in farming and in nonfarming industries. Colin Clark using 1929 data and T. W. Schultz using 1939 data computed average productivities for agriculture in several states in each geographic area.[1] Bishop using 1944 data made comparisons of farm efficiency among selected states in the Southeast and the Cornbelt.[2]

This paper reports a study completed to give additional insights into the relative efficiency of American agricultural sectors. The study was made for two reasons: (1) Comparatively little has been known about the productivity of resources in relatively homogeneous farming regions. Earlier studies have aggregated dissimilar producing regions. (2) Also previous studies have not dealt with resource efficiency relative to the prices of the factors and total inputs. This study, therefore, gives new slants on the relative efficiency of particular sectors within agriculture. First, it pin-points a good many areas that stand out in degree of efficiency or inefficiency, but which were obscured by the broad groupings in other studies. Second, it shows that when resource prices are considered, the relative efficiency of a good many areas is reversed. All the Midwest, for example, appears to be efficient relative to all the Southeast when groupings are broad and the productivity ratio is value of output divided by physical units of labor or land. When regions are delineated on the basis of criteria used in this study, however, and value of output

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* Journal paper J-2719 of the Iowa Agr. Exp. Sta., project 1135. For the full study on which this paper is based see *Productivity of Resources Used on Commercial Farms,* USDA tech. Bul. (in press), by E. G. Strand, ARS, USDA, Earl O. Heady and J. A. Seagraves, Iowa State College.

[1] See Colin Clark, *The Conditions of Economic Progress,* London: The Macmillan Company, 1940. and Theodore W. Schultz, *Production and Welfare of Agriculture,* New York: The Macmillan Company 1949, Ch. 7.

[2] C. E. Bishop, "Underemployment of Labor in Southeastern Agriculture," *This Journal,* Vol. 36, May 1954, pp. 258-72.

is measured in relation to value of input, numerous of these rankings are reversed.

The report focuses only on regional differentials and the comparisons are based on average productivities. No attempt is made to compare strata within regions. Further stratification of farms by capital used and measurement of efficiency via marginal resource productivity, which would provide conclusions beyond those enumerated, must await further analysis. The data of this study refer (1) to commercial farms (economic classes I through VI) and (2) to resources used on these farms and their product. Income and the product from off-farm work are not included. Off-farm employment represents an important use of resources in some regions, particularly in industrial regions such as parts of the Southeast and New England, or in other metropolitan areas. In some of these regions, addition of the income of farm people in off-farm employment to their income from farming raises the average return for all farm-directed resources above that of other regions where off-farm employment opportunities are less readily available.

Our data, drawn from the 1950 Census of Agriculture, provide estimates for 68 different productivity regions of the United States. The productivity regions were delineated in terms of the crops produced, and the basic soil and land resources. Thus the regions were formed by grouping selected economic areas.[3] These steps were taken to eliminate discrepancies that arise when entire states are grouped together. This permits identification of differentials that exist among farms within the same region in respect to resource productivity. Preliminary analyses suggest that some farms have a very high productivity in regions where the average productivity of all units is low and many farms have a very low productivity in regions where the all-farm average is high. These productivity differences exist within every region and perhaps are explained by the same general phenomena that describe differences among regions.

The year 1949 is a benchmark year in certain respects. It fell between World War II and the Korean outbreak; the existing prices were mainly expressing consumer desires for civilian goods and services. Hence the basic information provides a framework for measuring the relative value placed by consumers on the products produced and the quantity of re-

[3] State economic areas are subdivisions of states and consist of single counties or groups of counties that have similar economic and social characteristics. See *State Economic Areas*, Bureau of the Census, U. S. Dept. of Commerce, Washington, D.C., 1951. See also *Generalized Types of Farming in the United States, Including, a List of Counties in Type-of Farming Regions and Subregions*, Bureau of Agricultural Economics, U. S. Dept. of Agriculture, Agriculture Information Bulletin No. 3, 35 pp. and map, Washington, D.C. February 1950.

sources used in particular farming regions. The data are superior to those used in previous studies done in wartime or earlier years in indicating the direction in which resources now in agriculture might best flow if the level of national income is to be at a maximum. Other benchmark studies for subsequent points in time when economic organization is approaching an equilibrium state would also be valuable. Although weather was not entirely uniform over the entire nation, crop yields were not particularly depressed at any location. An analysis made for a period of years would likely give the same findings, although they would differ in years of drouth in some areas.

Productivity Areas, Inputs per Farm and Income for Family Resources

Figure 1 shows the total value per farm of all inputs in 1949. Inputs

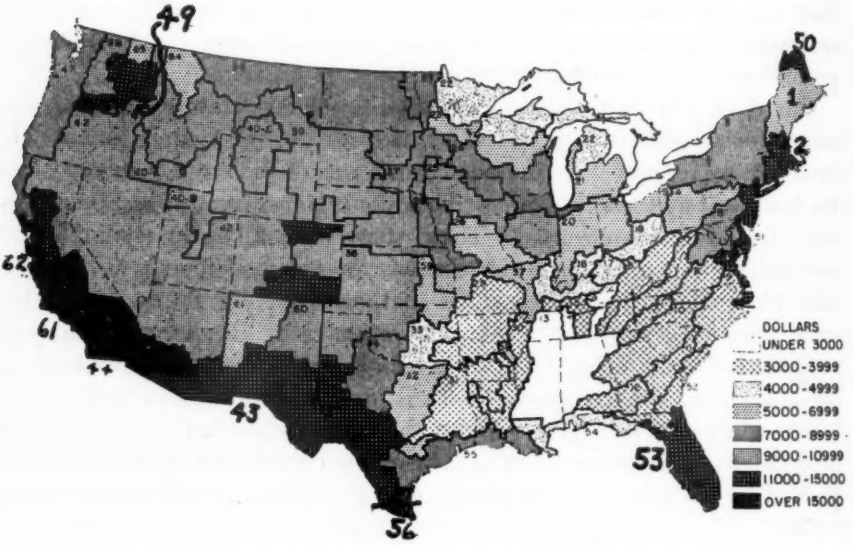


FIG. 1. TOTAL VALUE OF ALL INPUTS PER COMMERCIAL FARM, 1949.

include: livestock and feed purchases; annual cash expenses for operation; depreciation on machinery, equipment and buildings; interest on investments, including land; and labor valued at market wage rates. Total inputs averaged $6,448 per commercial farm for the U.S. There is, however, a large variation among regions. Inputs per farm, including the value of labor, vary from $2,548 for central Tennessee and southern Kentucky to $24,276 for region 44 in Arizona. Area 50 in Maine has larger inputs per farm than the major ranching areas or the areas of most productive soils in the Corn Belt. Regional differences in the quantity of

total inputs follow much the same pattern as the differences in total value of product per farm. As a result of the large differences in the quantity of resources used, the large differences in efficiency pointed out later are expected.

Labor Productivity

Labor is the most important single input item throughout the major part of American agriculture. Labor has a greater value, if priced at market wage rates, than the annual services of land or other capital items. Labor also is the agricultural resource having the greatest flexibility in use. Except for industrial locations, land cannot be transferred for the production processes of nonfarm industries. Capital, once it has been fashioned into machines and other tools of agriculture, has few alternative uses elsewhere. Certain restrictions also apply to alternative uses of labor. These include individual skills and preferences for particular locations and types of work. Since the labor input is so great, however, analysis of its use is one of the most important parts of this study. A large number of farm families can attain a desirable level of living only as the productivity of their labor is increased. Areas of low labor productivity generally are those of high capital productivity since labor is used in large amounts relative to the capital employed with it. The characteristics of labor supplies and productivities that follow suggest the magnitude of the differentials in labor/capital ratios and also suggest reasons for the great variations among regions in labor productivity.

Gross Product per Worker

Gross labor productivity is a measure of labor returns. The computation is made by dividing the total product per farm by the total number of workers per farm. This quantity, shown by regions in figure 2, indicates the total product resulting from the equivalent of one man and the capital he used; but it does not impute any of the total value of product to capital. In this case labor productivity would largely depend on the amount of capital used per man.

Total gross product per worker was highest in the diagonal strip of the Corn Belt that includes the Clarion-Webster, Tama-Muscatine and Drummer-Flanagan soils. But gross product was almost equally high over the heart of the winter wheat areas stretching from Texas to Nebraska and in southern California, southwestern Arizona. It was highest in region 49 including parts of Washington, Idaho and Oregon. Region 49 includes productive wheat farms and irrigated fruit farms. Although the two inputs are not perfectly correlated with investment per worker, these regions in general were the same ones that had a high investment or a high current

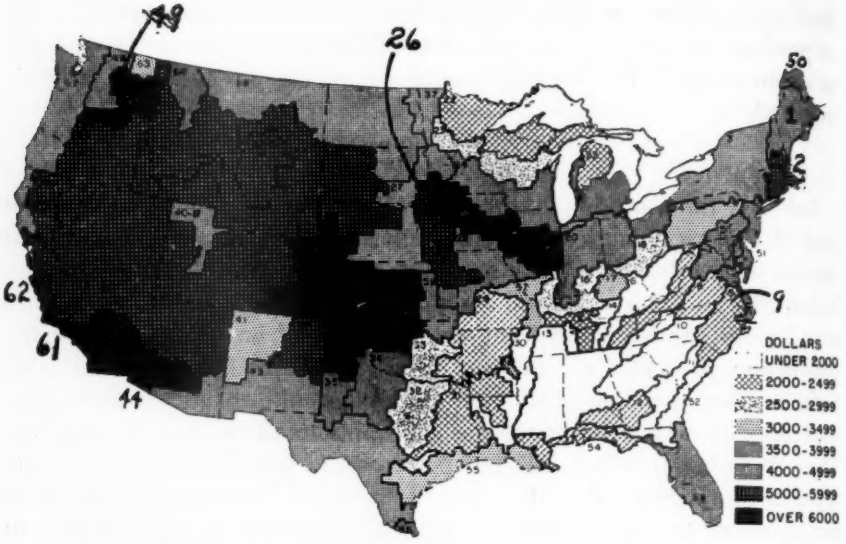


FIG. 2. VALUE OF TOTAL PRODUCT PER FARM WORKER ON COMMERCIAL FARMS, 1949.

annual expense input per worker. The large gross product per worker resulted not only because labor productivity was high but also because of the large amount of product attributable to capital.

Second high in gross product per farm worker was that large expanse of territory stretching from the Sierra Nevada mountains to the Rocky mountains and including the main ranching areas of western Nebraska, South Dakota and eastern Wyoming. As a whole this large area ranked second in total investment and total annual inputs (current expenses except labor inputs) per worker. In a somewhat similar position (in respect to gross product per worker and capital inputs per worker) was area 26 on the western fringe of the Corn Belt. Area 2 in New England had a similar product per worker, but it had a much lower capital investment per worker and a higher annual capital input for current expenses including large purchases of feeds for dairy herds and poultry flocks, fertilizer, and spray materials for potatoes and vegetables.

Gross product per worker was extremely low in some part of every state falling within the broad category of the Southeast. Product per worker was less than $2,000 in regions 30, 13, 14, 6, 10, 11 and 52. Included in this overall area is the heart of the Appalachian Mountains stretching from Pennsylvania through eastern Kentucky and Tennessee. It also includes a major portion of Mississippi, Alabama, Georgia and the Carolinas, and parts of Louisiana, Arkansas and Florida.

Residual Product per Worker

Although the figures discussed above are useful for certain comparisons, they have an important limitation. The product of capital is not deducted in expressing relative labor returns. Aside from certain exceptions pointed out elsewhere, the gross product of labor will be greatest in types of agriculture that use the greatest amount of capital, even if labor productivity does not actually differ.[4] Table 1, showing residual product per worker after a share of the total product has been imputed to capital, is used to partially eliminate the difficulty outlined above. The difficulty is only partially eliminated, however, since the share inputed to capital is an average market price for capital resources rather than the marginal product. The share has been computed (1) by subtracting from gross product the value of annual expenses on crops and livestock, depreciation and interest on capital, and (2) by dividing the remainder by the number of man-equivalents (12 months) of labor.

The two outstanding regions in respect to residual product or income per worker were 44 and 49. Region 44 was favored by a combination of forces including a near year-long growing season for citrus fruit, cotton, vegetables and grass seeds; irrigation; large farms; and large annual capital inputs or current expense per worker, although the region was in an intermediate position in respect to capital investment per worker. A somewhat similar situation existed in region 49 where irrigation, a favorable price for fruit, and deep soils favorable for wheat yielded a very high residual income per worker. Region 49 not only had a large crop acreage per worker but very high ratios of capital investment and current expenses per worker.

Second high in residual income per worker were the fruit, vegetable

[4] Suppose that capital produces a return of 5 percent and labor produces a return of $2,000 per laborer in each of two regions, A and B. Region B uses $80,000 and two workers per farm; region A uses $5,000 and one worker per farm. The gross product per farm in region B will be $4,000 from capital and $4,000 from labor, a total product of $8,000. If the $8,000 is divided by the number of workers (2), the gross product per worker is $4,000. In region A, the gross product per farm will be $250 from capital plus $2,000 from labor, a total of $2,250. The gross product per worker is $2,250. Hence region B appears to have a higher gross labor product. This illusion grows out of the fact that no product has been imputed to the capital that produced it. If we subtract the capital return ($80,000 at 5 per cent) from the total product in region B, we have a remainder for labor of only $4,000. The product per laborer is $2,000 just as it is in region A when $250 is allocated to capital. For other notes on computing input-output ratios, see the chapter on incomparability of national income aggregates in S. H. Frankel, *Economic Impact on Under-Developed Countries,* Harvard University Press, Cambridge. 1953. Also see Earl O. Heady, *Productivity and Income of Labor and Capital on Marshall Silt Loam Farms,* Iowa Agr. Exp. Sta. Bulletins 401 and 412.

TABLE 1. RESIDUAL PRODUCT PER WORKER ON COMMERCIAL FARMS, BY PRODUCTIVITY REGIONS, 1949

Productivity region	Residual income per worker			Productivity region	Residual income per worker		
	All labor	Operator and Family labor	Operator		All labor	Operator and Family labor	Operator[1]
	Dollars	*Dollars*	*Dollars*		*Dollars*	*Dollars*	*Dollars*
1	1,210	1,119	1,020	36	1,720	1,822	1,982
2	1,705	1,852	1,947	37	1,796	1,832	1,884
3	989	728	353	38	1,483	1,425	1,285
4	509	260	−534	39	1,539	1,490	1,391
5	780	414	− 68	40A	1,749	1,674	1,595
6	502	430	185	40B	1,163	886	478
7	517	426	195	40C	1,494	1,368	1,201
8	1,070	1,075	1,095	40D	2,133	2,487	2,858
9	1,131	1,172	1,307	40E	2,158	2,628	3,034
10	506	440	246	41	622	322	−257
11	705	680	624	42	1,517	1,354	1,179
12	830	838	877	43	1,330	1,420	1,476
13	580	545	458	44	3,926	15,931	21,045
14	602	577	452	45	2,746	5,649	6,983
15	759	740	706	46	2,431	3,402	3,983
16	788	725	508	47	1,258	903	393
17	1,173	1,277	1,393	48	2,218	2,409	2,534
18	716	593	235	49	2,817	3,376	3,853
19	823	623	222	50	2,051	3,751	4,433
20	1,182	1,148	1,084	51	1,260	1,172	1,097
21	912	756	452	52	520	405	188
22	658	557	−37	53	2,088	5,968	7,421
23	893	810	344	54	598	500	323
24	1,263	1,188	993	55	1,283	1,487	1,664
25	1,855	1,899	2,000	56	2,064	4,695	5,651
26	1,306	1,262	1,130	57	1,298	1,311	1,327
27	1,282	1,238	1,026	58	1,447	1,838	2,073
28	1,181	1,148	1,043	59	924	832	464
29	517	445	126	60	1,419	1,435	1,456
30	967	1,051	1,103	61	2,605	4,136	4,979
31	744	654	469	62	2,255	3,009	3,462
32	1,034	927	815	64	470	307	−779
33	676	537	135	65	926	723	238
34	1,627	1,956	2,169	United States	1,208	1,156	1,095
35	2,404	5,867	6,948				

[1] Residual per full-time equivalent operator after deducting the estimated value of unpaid family labor and all other inputs.

and general cropping areas of California (regions 45, 46, and 61) and region 35 in Texas. In a third category were regions 48 in Washington, the central California coastal area, the productive prairie soils of the Corn Belt, the peninsula of Florida and the intensive potato region in Maine. These regions largely specialized in cash crops, with farms on a medium to large scale, having favorable capital/labor ratios and soils and climate favorable to the particular crop specialities. Next come most of the Great Plains (and bordering regions) plus most of Connecticut,

Rhode Island and Massachusetts with a residual income of $1,400-$1,799 per worker.

At the bottom of the list were several regions in the Appalachian Mountains and the Southeast, region 29 covering parts of Oklahoma, Missouri, and Arkansas, and region 63 in northeast Washington. Residual income per worker was less than $600 in all of these regions. The capital investment of less than $6,000 per worker was low, but it was no lower than for bordering regions such as 11, 12, and 30. The latter regions had incomes per worker as high as regions 15, 16, 18 and 19, stretching from northern Ohio to Tennessee, and as high as in regions 22 and 23 in the upper North Central region. Low residual income per worker was not restricted to the Southeastern regions but was found throughout the entire eastern half of the nation intermixed among areas of considerably higher incomes.

This study could not determine how techniques of farming affected income and resource productivity. Although effects of differentials in capital can be pointed out, without detailed analysis of the effect of changing techniques on resource productivity, relatively too much emphasis would focus on capital. Some increase in resource productivity can be attained from changing techniques with given capital levels, but this study was not designed to explain the extent to which these alternatives existed.

Productivity in Relation to All Resources Used

One of the best measures of average resource productivity and efficiency is the relation of production to all resources used in farming. Although this measure is not perfect since it does not express differentials in marginal productivity it has these advantages: (1) It considers the prices paid for all resources, the magnitude of the residual left to one category of resources does not depend on over-pricing or under-pricing another resource in relation to its actual productivity. (2) The residual to any one resource is not so much a function of the scale of operation or amount of other resources used. (3) Aggregate productivity of all resources is measured together. The method cannot indicate which resource is used in excess, however, and which one is used in too small quantities.

Figure 3 allows interregional comparisons of this nature. The ratios show the value of output for each $1 annual input of labor and capital. The value of labor was computed by multiplying the amount of all hired, operator and family labor by the wage rate for hired farm labor. Annual capital inputs were computed by adding (1) all current or annual expense and (2) interest charges, at market interest rates, on all working and fixed capital. The total value of product of each region was then divided by

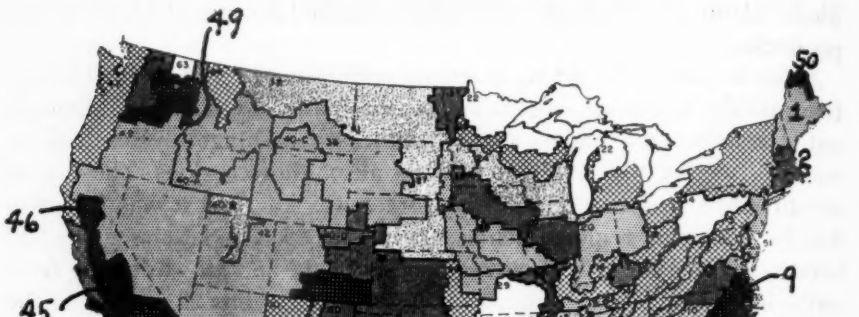


FIG. 3. VALUE OF OUTPUT PER DOLLAR VALUE OF INPUT ON COMMERCIAL FARMS, 1949.

the sum of the value of labor and capital expenses or inputs as described above. This output-input ratio, as it will be called henceforth, suggests not only the efficiency of production in each region; it also indicates whether, if market prices for resource services had been paid in each region, the production process would have resulted in a net loss or a net profit. A ratio of more than 1.0 indicates that the value of production was greater than the value of annual input and, therefore, resulted in a profit to the average farmer. A ratio of less than 1.0 indicates that the value of production was less than the value of the resource services used and, therefore, would have resulted in a loss had the farmers paid market prices for all inputs. We might also consider the ratios in this vein: If the ratio is greater than 1.0 society placed a greater value on the product than on the resources used to produce it. As pointed out before, however, farmers ordinarily do not pay wage rates on their own or family labor and interest on their own capital. Hence, even where the ratio is less than 1.0, families have some income available for living expenses. The amount of income available for living, however, depends particularly (a) on the magnitude of this ratio and (b) on the quantity of resources and/or the volume of production.

The pattern of output-input ratios over the many regions is somewhat similar to some of the labor productivity ratios discussed earlier. Some important differences, however, stand out. The two regions with the highest ratios were 44 in southwest Arizona and 35 in west central Texas.

Region 44 had a larger volume of output per farm than any other region in the nation; region 35 was outranked by only three other regions. The average value of production per farm was $38,473 in region 44 of Arizona while in region 35 it was $16,588. At the other extreme, region 63 of northeast Washington had an output-input ratio of only .66 and a volume of output per farm of only $4,083; region 22 around the Great Lakes had a ratio of only .73 and a $3,316 volume of output per farm; region 33 in Oklahoma had an output-input ratio of only .78 and a volume of output per farm of only $3,646.

Also outstanding in output-input ratio is region 56 at the tip of Texas, region 45 in central California, Aroostook County in Maine, and the Florida peninsula. These regions are composed mainly of large farms using considerable amounts of hired labor, fertilizer and related inputs; the level of management also is high in all of these regions. These regions are by no means homogeneous, however, in respect to volume of output.

The Maine and Texas regions approached $15,000, the Florida peninsula had $16,514, while central California had an average output of $22,509 per farm. Total capital per worker was more than $10,000 in the California and Texas regions and between $6,000 and 8,000 in Aroostook County.

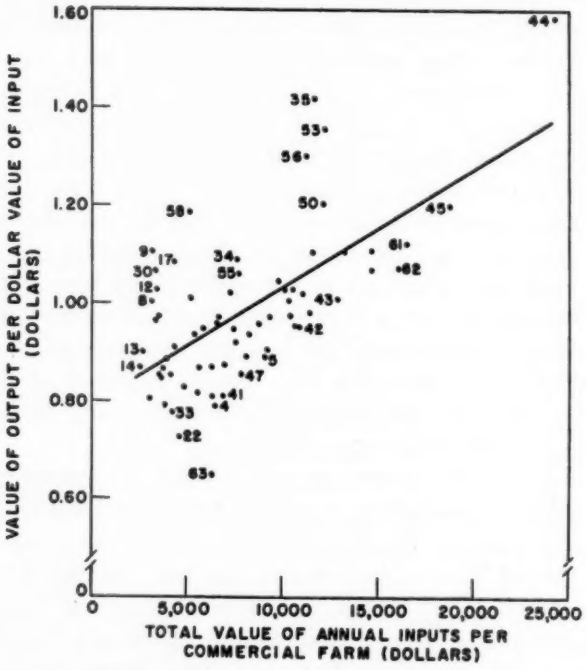
The next-ranking regions in respect to output per unit of input were found widely scattered over the nation, except in the Midwest. This group, with ratios falling between 1.10 and 1.20 was found in region 49 in Washington and Oregon, regions 46 and 61 in California, region 40E in Colorado, region 58 in Arkansas, and region 9 covering the Coastal Plain of Virginia and the Carolinas. It should be remembered, of course, that this ratio is not an expression of physical output per unit of physical resources; it measures the value of output per dollar value of input. Accordingly, one region can have a larger physical output per unit of labor or physical capital than another region and still can have a lower output-input ratio because the price of resources in the other region is relatively low. For example, the physical product per worker was larger in region 25 in the diagonal of the Corn Belt than in region 9 of the Southeast (see figure 2). Still, the output-input ratio was greater in region 9. This was partially because wage rates were lower.

A large portion of the nation was included in an output-input ratio in which the value of production exceeded the market value of the inputs by less than 10 percent. The Red River Valley, the diagonal of the Corn Belt, north central Washington, most of the hard winter Wheat Belt, the southwest range area of Texas and New Mexico, the Texas-Louisiana Gulf Coast, and a small area of Georgia and Alabama fell in this category. Most of the remainder of the nation west of the Mississippi had a ratio of .95 to 1.00. A ratio of this magnitude was also found in region 1 in Maine,

in the Piedmont, and in the eastern and southwest part of the Corn Belt. South of this vast area of the nation were those regions with a ratio of .80 to .95 marked off by a diagonal running from Vermont, New York, Pennsylvania and Ohio all the way to the Gulf Coast. The upper Pacific Coast, northern Utah, northwest New Mexico, parts of Montana and the Dakotas and some of the western Corn Belt were also in this category, as were areas bordering on the Great Lakes and a strip along the South Carolina-Georgia coast. Even though wage rates were low in many of these areas and capital inputs per farm were small, the value of output was low relative to the price of resources.

Some Possible Explanations

Numerous factors explain variations in the output-input ratio, i.e. the value of output produced per dollar of all annual resource inputs. Chief among these seems to be the scale of input. The fairly close relationship between the output-input ratio and the value of input per farm is illustrated in figure 4. With a crude national approach, this single variable "explains" about 40 percent of the interregional variation in the output-



. FIG. 4. RELATION BETWEEN OUTPUT-INPUT RATIO AND VALUE OF ANNUAL REPORT PER COMMERCIAL FARM, 1949. NOTE: EACH DOT INDICATES A REGION. SPACE LIMITATION PREVENTS SHOWING REGION NUMBERS OF ALL DOTS.

input ratio. The aggregate measure of production relationships indicate some fairly large economics of scale. A $1 input produced a greater value of output when it was used with a large aggregate of inputs or resource services. According to the data of figure 4, at 1949 prices a total value of input smaller than $8,750 resulted in an output-input ratio of less than 1.0; a value of input greater than $7,000 resulted in a ratio greater than 1.0, and the magnitude increased directly with the value of input per farm. These figures mean that larger farms gained in income more than proportionately to the increase in the size of unit as compared with the national average.

One of the obvious causes of low income and productivity in the many regions pointed out above is the small scale of farms and the small amount of resources used per unit of labor. This is particularly true in regions such as those in the general boundary of region 4 through 6 and 7 over to 9 on the Atlantic coast, down to 52 and across to 30. It also is true for regions 22, 29, 33, 63, and other scattered locations. Substantial increases in the productivity of labor and farm family incomes in these regions can be brought about only as farms use a greater quantity of resources other than labor and attain a greater volume of output. Also, in the main, improvement can come about only as there are fewer farms.

Volume of input, however, does not fully explain interregional differences in the output-input ratio. If it did, all of the data for individual regions would fall on the regression line in figure 4. Some regions such as 9, 35, and 58 fall far above it. Others such as 22 and 63 fall far below it. An important part of further productivity analysis will be to discover reasons for these large deviations in the general tendency or regression shown in figure 4. One reason for deviations above the line is efficient management of given resources, along with relatively large economies of scale for a given type of production. Another possibility is that some or all resources are priced at a level much lower than their average productivity. In regions such as 44, 50, 53 and 56, where a large amount of hired labor is used, the marginal productivity of labor (or of labor and capital) is certainly much higher than its price. Hence, a large net product, or profit, exists. Regions such as 63, 33, 4, 29, and 22 may have an output-input ratio that is low relative to the regression line because of the high price of resources relative to their productivity, because of a type of production not particularly related to economic demand, or because scale economies are perhaps very small for the particular products and techniques.

Efficiency in Relation to Product and Factor Prices

The efficiency comparisons are related to product and factor pricing. The manner in which regions 44, 45, 46 and 53 stand out in all of our efficiency comparisons is noteworthy. The high labor product and the

large value of output per dollar of input of resources in these regions resulted (1) because farms used a large annual capital input per worker, (2) because scale economies apparently were important and (3) because the average value product of resources was higher than the average price of resources. Prices are also important in this way: The commodities produced in these regions, particularly the vegetables and fruits, were those that a developing economy values highly among agricultural commodities. Income elasticities of demand are relatively high for these commodities. In a developing economy these will be priced highly to shift more resources into these types of production. Region 50 was similar except that the high price of 1949 resulted from government support prices for potatoes. The support price was high enough to give a high value of output per combined input of all resources. The magnitude of the ratio was high enough to be as favorable, in encouraging the use of more resources for the particular line of production, as market prices for fruits and vegetables.

Efficiency in Relation to Quantity and Price of Resources

The central Corn Belt (region 25) ordinarily is pointed out as a model of efficiency ranking high on the basis of gross product per worker. This is partly true, however, because such a large amount of capital is used per worker (see figure 5). When the amount of capital and the price of capital resources were considered, however, this region ranked no higher than regions that are not similarly held up as models of production. It ranked no higher than regions 8 and 12, which are often ranked as a part of a broad area of low productivity in the Southeast. Similarly, figure 2 shows that the eastern part of the Corn Belt (including most of Indiana, Ohio and Michigan) had a greater gross product per worker than region 9 along the seaboard and region 11 stretching down the Piedmont. In terms of output per unit of all inputs (figure 3), region 9 ranked higher than any region bordering on the central Corn Belt or in a vast part of the expanse west of the Missouri. Likewise region 11 was at least equal to these regions, while some regions, such as 29, remained low on all counts.

Thus agriculture in some of the Southeastern areas, although less efficient on basis of gross product, was not less efficient than agriculture in the Corn Belt, the Great Plains and the West on basis of the output-input ratio of figure 3, and relative to the prices of the resources involved.[5] In regions stretching from the Appalachians to the Gulf of Mexico wage

[5] Support prices for tobacco probably affected output-input ratios in about the same way as support prices for potatoes.

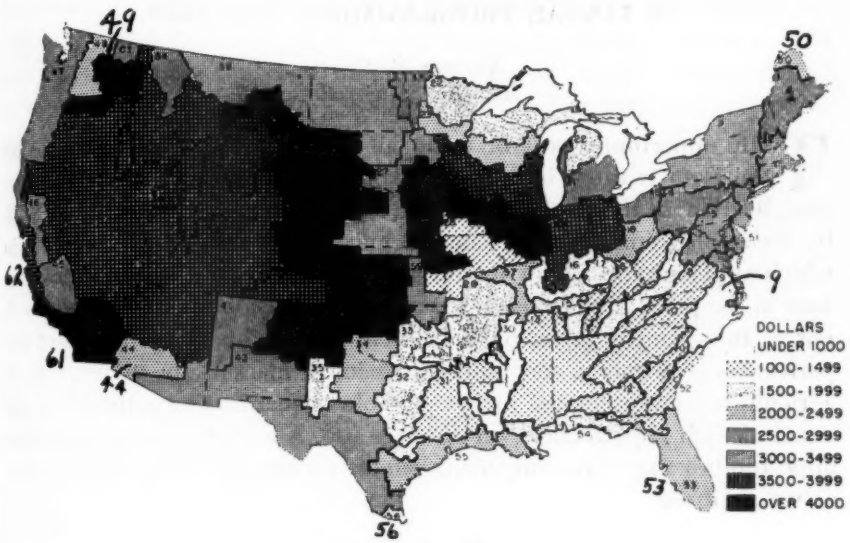


FIG. 5. VALUE OF ANNUAL INPUT OF ALL CAPITAL PER WORKER ON COMMERCIAL FARMS, 1949.

rates are low as a result of the backlog of labor in these regions. Under these low wage rates, efficient farm production is consistent with a low gross or physical product per worker. Farm managers can afford to use labor with a low gross value productivity even though, from the standpoint of the total economy, such use of labor is not efficient. As long as the economic system results in a large pool of labor and low farm wage rates in areas such as 9 or 11, use of such low priced labor will result in a small product per worker but a favorable output-input ratio relative to the value of all resources used.

PERFECT VS. DISCONTINUOUS INPUT MARKETS: A LINEAR PROGRAMMING ANALYSIS[1]

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THE opportunity cost of using an input produced or available on the farm is often less than the purchase price of that input. This complication in the problem of farm organization is readily dealt with by linear programming. The same technique can be used for any case in which different lots of an input[2] are obtainable at different prices, as long as the price at which each separate portion is obtainable is independent of the quantity taken by the firm studied. This type of market imperfection is common, in output as in input markets, in industry as in agriculture.[3] Programming makes possible a quantitative estimate of the effect of such imperfections on resource use. A modest change in market opportunities may have surprising effects on optimal farm organization, as we shall see.

The Problem

We shall compare optimal beef-cattle feeding programs for the same farm in two different market situations:

(1) Corn can be bought or sold at $1.49 per bushel; hay can neither be bought nor sold. The market for corn is perfect; there is no market for hay.[4]

(2) Both hay and corn can be bought or sold, but buying and selling prices differ. This creates a "discontinuous" market for inputs. The opportunity cost of corn grown on the farm is $1.49 per bushel, as that is its price if sold; to buy additional corn, however, the farmer must pay $1.64. Hay, which can be sold for $16 a ton, will cost $20 if purchased.

The farm is a 250-acre central Michigan farm with 60 acres of pasture and an annual output of 80 tons of good alfalfa hay. We wish to choose a beef-cattle feeding enterprise, taking the other farm enterprises as given,

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[1] The author is heavily indebted to Professor Lauren H. Brown, who suggested beef-cattle feeding as a problem, specified the characteristics of the farm to be studied, and served as a guide to sources of data. Professor Glenn Johnson suggested that the two-price problem for inputs deserved analysis.

[2] The technique applies as well to output markets.

[3] Either discriminatory pricing by a single firm or differences among the selling prices of several firms (when one's custom is regularly divided among them) may cause such an imperfection.

[4] Case (1) is the type of market assumed by Earl R. Swanson and Kirk Fox. "The Selection of Livestock Enterprises by Activity Analysis," *This Journal*, Vol. XXXVI, Feb. 1954, p. 81.

and operating within the limits specified in Table I.[5] Only the "funds" item requires explanation. Command over funds (circulating capital) is not only an important limitation in practice, but a farmer's willingness to assume risk is indicated by the amount that he is willing to invest in such a venture.

Our man is assumed to be willing to devote to cattle feeding $1,511.44 of his own cash plus the $3,188.56 sale value of his 149,798 pounds of

TABLE 1. LIMITED FACTORS

Factor	Quantity Available
Hay Grown on Farm	160,000 pounds
Pasture	60 acres
Summer Labor (April through October)	418 hours
Winter Labor (November through March)	906 hours
Shelter	3,500 square feet
Funds	13,480[a] dollars
Corn Grown on Farm	149,798[b] pounds

[a] When there is no market for hay, only $12,200.
[b] Not a limiting factor when the market for corn is perfect.

corn, a total of $4,700. He is willing and able to borrow $7,500.[6] He will also invest the sales value of his own hay, $1,280 in market situation (2) but zero in market situation (1). Thus his total command over funds is $13,480 in market situation (2) and $12,200 in market situation (1). With these funds he must buy his feeder stock, his protein supplement and his corn ("buying" the latter at least in part from himself).[7] The lower stock of funds in market situation (1) is in recognition of the fact that in this case hay need not be purchased; in case (2) his funds must also pay for hay "purchased" either from himself or from others. Interest on the borrowed portion of funds is assumed payable out of proceeds; it is not a drain upon the stock of funds initially available.[8]

Essentially we are studying substitution possibilities among hay, pasture, corn, labor, funds, etc. As an approximation to the complete production surface we consider seven cattle-feeding processes which cover a

[5] The treatment of Swanson and Fox was more sensitive with respect to the labor available, which they specified by months. However, they ignored requirements for shelter and funds. They treated pasture as convertible into hay, which we have not done. (*Op. cit.*, pp. 80-83.)

[6] Plus whatever extra funds may be required for carrying one feeding program to completion simultaneously with starting a new lot (should systems taking more than a year prove profitable).

[7] Thus we also provide a solution for the firm which must choose between selling certain portions of its products and using them as inputs in the production of other outputs.

[8] Using funds as a limiting factor in this way makes it unnecessary to introduce separate processes for corn, protein and feeder cattle buying, as was done by Swanson and Fox. (*Op. cit.*, p. 83.)

rather wide range of alternative proportions among these inputs. Physical budgets and price data are given in Table II. In all cases the animals are purchased on October 15. For each age of feeder animal the first of the processes listed is dry lot fattening on full grain. The remaining processes make progressively more use of hay and pasture.

We wish to maximize the net revenue obtainable by using one or more of these feeding systems, without using more of any limited factor than we have available. Net revenue is defined as the value of the finished steers less the cost of the feeder animals, corn,[9] and protein supplement, and less an interest charge of 5% on the value invested in feeder stock. We allow for a two per cent death loss occurring when the animals have made half their gain.

After computing the net revenue from a lot of 102 feeders for each of the seven feeding systems it is a simple matter to compute each system's requirements of the several limited factors per $1,000 of net revenue. With this information we are ready to apply simplex computation procedures.[10] Market situation (2) is handled by replacing each of the seven physical processes by four new processes. Instead of Process 1 we have Processes 1a (in which are fed hay and corn valued at the lower of their two prices), 1b (in which the hay is purchased at the higher price, but the corn is still low-valued), 1c (in which both hay and corn are purchased at the higher prices), and 1d (in which the hay is low-valued but the corn is high-valued). The same pattern is followed for each of the seven physical processes.

Optimal Organization

Case 1: When the market for corn is perfect but hay has no alternative uses, the optimal program is as shown in Table III, assuming perfect divisibility of processes.[11]

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[9] And hay, in market situation (2).

[10] As developed in A. Charnes, W. W. Cooper, and A. Henderson, *An Introduction to Linear Programming*, John Wiley & Sons, New York, 1953.

[11] Eliminating fractions of animals, we have 32 on Process 1, 34 on Process 4, and 3 on Process 7, yielding a total net revenue of $7,107.

The appearance of three two-year-olds in the optimal program calls to mind certain features of reality that were abstracted from in the linear programming calculation. That calculation assumes that requirements per animal are not affected by the number of animals fed on a single process, but actually labor requirements per animal are larger if the lot is as small as three. Likewise the number of processes to be combined is assumed to be immaterial, but in fact adding a process increases the complexity of the herdsman's problem and may increase transportation costs between farm and market (which we have ignored). The farmer will have to judge whether or not the three two-year-olds are worth troubling with in the light of these considerations. We can tell him what his financial sacrifice will be: a reduction of net revenue from $7,107 to $6,923 if he cuts out the three, with the opportunity of restoring it to a figure of $7,042 by replacing them with one added calf on Process 4.

TABLE II. DATA[a]

TABLE II. DATA[a]

Unit: 1 animal, assuming no death loss

		Inputs									Output	Prices that Vary with the Process		Other
Feeding System (Process)		Starting Weight (Pounds)	Corn & Cob Meal (Pounds)	Protein Supplement (Pounds)	Hay (Pounds)	Spring & Summer Pasture (Acres)[b]	Summer Labor (Hours)[c]	Winter Labor (Hours)[c]	Shelter (Square Feet)[d]	Elapsed Time (Months)[e]	Finished Weight (Pounds)	Feeder Stock (Dollars per Hundred Pounds)[f]	Finished Steer (Dollars per Hundred Pounds)[g]	Price[h]
Calves	1	450	2,880[i]	420	1,560	0	6.5	6.5	30	9.5	1,000	24.88	29.00	Corn: $1.49 per Bushel
	2	450	1,960	60	2,520	.31	6.5	3.5	30	11.0	935	24.88	28.42	
	3	450	1,935	143	2,880	.73	7.0	4.0	30	13.0	1,050	24.88	27.29	
	4	450	1,500	200	3,120	1.00	6.0	5.5	30	13.7	1,050	24.88	26.93	
Yearlings	5	775	2,175	300	1,050	0	.5	9.0	45	6.0	1,175	23.76	27.24	Protein Supplement: $85.00 per Ton
	6	600	2,900	200	2,400	1.24	7.5	3.0	40	12.5	1,160	23.76	27.05	
Two-year-olds	7	850	1,400	143	760	0	.2	6.0	50	4.0	1,125[j]	23.28	27.01	Interest Rate: 5% per Year

[a] Except for Process 6, data on weights, feed consumption and duration of process are from Departments of Animal Husbandry and Agronomy, Purdue University, "A Comparison of Different Systems of Feeding Beef Cattle with Special Emphasis on Utilization of Hay and Pasture," Memo No. 666-31, January, 1948, pp. 5–9, 14, 15. Process 6 data from Dr. Lauren H. Brown, after checking with Animal Husbandry Department, Michigan State College.

[b] The Purdue estimate of pasture requirements (*Ibid.*, p. 15) was raised by ½ to allow for the shorter season in Michigan. We assume that the acreage requirements stated take into account the varying lengths of time the pasture will be used.

Obviously pastures of different quality have different carrying capacity. Our results may be made applicable to pastures of different capacity than that assumed here by considering the 60 acres of pasture available on the farm we are studying as the equivalent of 120 acres of pasture with half the capacity, and so forth.

[c] Labor requirement data are based on estimates furnished by Dr. Brown. The allocation between summer and winter labor is affected by the exact date on which one shifts from one phase of the feeding operation to another, and this date will be variable, depending upon the weather, the condition of the pasture, etc. Since the Purdue outline was not very precise in its estimate of time periods, certain inconsistencies have crept into our allocation of labor between the winter and summer months. However, the very nature of the labor estimates is such that we could hardly expect figures on requirements per animal to be accurate to less than the half hour, except for Process 7, which requires some summer labor, but clearly less than a half hour per animal. In fact, labor requirements per animal are not independent of the size of the lot of animals handled. (This is probably the only input for which non-linearity is a serious problem.) Our estimates assume that the animals are handled in car-load lots: about 40 calves, 35 yearlings, or 30 two-year-olds. Our final solution requires examination to ascertain whether the assumption of constant labor requirements per animal has introduced any serious error.

[d] Estimates of space requirements made by Dr. Brown.

[e] In view of the difficulty with dates referred to in footnote c, these figures must be regarded as somewhat approximate. They are used in the calculation of interest charges and in determining marketing dates, and thus the price received for the finished animal. The significant error, if any, is probably in the latter category.

[f] Yearling and two-year-old prices are October seasonal prices, adjusted for price level and trend, of choice stocker and feeder steers at Kansas City, 1938–50, in 1947–9 dollars. (Cox, C. B., Eisenach, E. J., and Mitchell, M. P., "Beef Cattle Prices," Purdue University, Agricultural Experiment Station Bulletin 582, January, 1953, p. 32.) We used the 500–800 pound class price for our yearlings and the 800–1000 pound class price for our two-year-olds.

Miller reports a spread of $1.12 between 650 pound good and choice yearlings and 420 pound good and choice calves in the average September–November price at Kansas City, from 1946–7 to 1951–2. (Miller, Earle E., "Profits from 4 Different Cattle Feeding Programs," *The Livestock and Meat Situation*, November–December, 1952, pp. 19, 20). The spread between yearlings and heavy animals (good grade) in his data was $.39; the spread between yearlings and two-year-olds in the data used above is $.48 for choice steers. Since the spreads were similar and the levels of prices comparable we added Miller's $1.12 to our price for yearlings to get a price for calves.

[g] Seasonal prices (adjusted for price level and trend) of choice slaughter steers in Chicago, 1939–50, in 1947–9 dollars, from Cox, Eisenach, and Mitchell, *Op. cit.*, p. 20. When our marketing date was not the middle of the month, we used straight line interpolation.

[h] *Agricultural Prices* for May 29, 1953, gave the price of corn per bushel on May 15 as $1.49. We have assumed that soybean meal at $85 per ton will be our protein supplement and have assumed a 5% rate of interest.

[i] We used the larger of two figures on corn consumption. (In other systems a single figure was given.)

[j] This is the mean of the end weight figures given in Purdue Memo. No. 666-31.

The optimal single process would have been Process 3, limited by its hay requirements to a net revenue of $6,475. The mixed program suggested here yields about 10% more net revenue from the beef cattle venture. To this must be added the $3,189 value of his 2,140 bushels of corn, to get the total net return from his corn, hay, and beef cattle of $10,388.

TABLE III. OPTIMAL FEEDING SYSTEM WITH PERFECT MARKET FOR CORN AND NO ALTERNATIVE USE FOR HAY

Processes to Be Used			Unused Quantities of Limited Factors	
Process	Net Revenue from Process	No. of Animals to Be Purchased	Factor	Quantity Unused
1 (Calves—Dry Lot)	$2,932	32.7	Pasture	26 acres
4 (Calves—Hay and Pasture until Aug. 29, then Dry Lot)	$4,070	34.1	Winter Labor	486 hours
7 (Two-Year-Olds—Dry Lot)	$ 197	3.2	Shelter	1,334 sq. ft.
Total	$7,199	70.0		

Case 2: With discontinuous markets for both hay and corn, the optimal solution is as shown in Table IV. The net revenue figure looks low because we subtracted the $1,280 market value of hay grown on the farm when computing case (2) net revenue figures. Adding the $1,280 back again, to restore comparability with case (1), we have a net revenue figure of $7,787 from hay and beef together. Creating a market in which hay could be purchased made possible a gain of more than eight per cent in the

TABLE IV. OPTIMAL FEEDING SYSTEM WITH DISCONTINUOUS MARKETS FOR HAY AND CORN

Process to Be Used			Unused Quantities of Limited Factors	
Process[a]	Net Revenue from Process	No. of Animals to Be Purchased	Factor	Quantity Unused
3a (Low-Priced Hay and Corn)	$ 818	8.7		
3b (High-Priced Hay; Low-Priced Corn)	$1,142	13.8	Winter Labor	536 hours
4a (Low-Priced Hay and Corn)	$4,185	44.2	Shelter	1,189 sq. ft.
7b (High-Priced Hay; Low-Priced Corn)	$ 361	6.9	Corn Grown on Farm	34,440 pounds
Total	$6,507[b]	73.6		

[a] The physical processes are as follows:
Process 3: Calves—Hay and pasture until July 15. Grain on pasture until Oct. 1, then dry lot.
Process 4: Calves—Hay and pasture until Aug. 29, then dry lot.
Process 7: Two-year-olds—Dry lot.

[b] Discrepancy in total caused by rounding error.

net return from these enterprises. As corn is again worth $3,189, the total net return from corn, hay and beef cattle is $10,976.

The most interesting feature of the solution is the disappearance of the excess of pasture. When hay could not be purchased, there were 26 acres of pasture unused;[12] when hay can be purchased, the excess of pasture is eliminated by buying more hay. Although hay and pasture may be technical substitutes at the same date and at a given level of output, they are here revealed in their true character as close complements with respect to a change in the level of net revenue. The complementarity occurs over time. Winter hay is a complement of summer pasture, and without adequate hay the pasture cannot be fully used. There is substitution of hay-and-pasture for corn-and-protein supplement, as the dry lot feeding of Process 1 gives way to hay-and-pasture using Processes 3 and 4. Indeed, some 460 bushels of corn are sold to help pay for the hay and a few more animals; in case (1) no corn was sold. Table V shows how the funds were used in the two cases.

TABLE V. ALLOCATION OF FUNDS IN THE OPTIMAL SOLUTIONS

Input	No Market for Hay; Perfect Market for Corn	Two Prices for Hay and for Corn
Feeder Stock	$ 8,118.13	$ 8,701.70
Protein Supplement	893.32	548.01
Corn	3,188.56	2,502.93
Hay	1,280.00[a]	1,727.32[b]
Total	$13,480.00[c]	$13,479.96

[a] Valued at $16 per ton; not included as a drain on funds in the first problem.
[b] Home-grown portion valued at $16 per ton; purchased portion valued at $20 per ton.
[c] Discrepancy from total of the parts caused by rounding error.

From the standpoint of total resource use, 460 bushels of corn and some 5,500 additional pounds of beef (liveweight) were made available to the economy in exchange for some 22 tons of hay and the use of 26 acres of pasture that had previously gone to waste.[13] The relationship between improved market organization and efficient resource use is clearly illustrated.

Marginal Value Productivities

Programming analysis also gives us measures of the marginal value productivities (imputed prices) of the limiting factors. Most attempts to value a nonmarketable factor are vitiated by the necessity of assigning

[12] Assuming, as often happens, that excess pasture was not converted into hay. Certainly next year's pasture cannot be converted into this winter's hay, though if we were planning for a longer period advance conversion might be possible.
[13] There were also shifts in the use of other inputs.

an arbitrary value to other factors that have no clear market value. Also they result in average rather than marginal values of the factor to be measured. Linear programming is free from both these objections.

Table VI contains the marginal value productivities under the two market situations, assuming that processes are completely divisible. In case (1), the loss of one pound of hay would reduce optimal profits by $.024. Alternatively, the loss of one dollar of available funds would reduce profits by $.18, or the loss of one hour of summer labor would reduce them by $2.65. Pasture, winter labor and shelter, available in excess of the quantities required, have marginal values of zero.

TABLE VI. MARGINAL VALUE PRODUCTIVITIES (IMPUTED PRICES) OF THE LIMITED FACTORS,[a]

Factor	No Market for Hay; Perfect Market for Corn		Discontinuous Markets for both Hay and Corn	
	Imputed Price	Total Income Imputed to Factor	Imputed Price	Total Income Imputed to Factor
Hay Grown on Farm	$0.0243 per pound ($48.60 per ton)	$3,885	$ 0.00244[b] per pound ($4.88 per ton)	$ 391[b]
Pasture	0.00 per acre	0	21.41 per acre	1,285
Summer Labor	2.65 per hour	1,108	4.50 per hour	1,880
Winter Labor	0.00 per hour	0	0.00 per hour	0
Shelter	0.00 per sq. ft.	0	0.00 per sq. ft.	0
Funds	0.18 per dollar of funds	2,200	0.22[c] per dollar	2,951[c]
Corn Grown on Farm	Not a limiting factor in this case		0.00 per pound	0
Total		$7,193[d]		$6,507

[a] In view of the data, these results probably have no more than two significant figures.
[b] This is the imputed value of the limited opportunity to buy hay at $16 per ton.
[c] This includes the imputed value of the opportunity of converting corn into money for use in purchasing other inputs.
[d] Had we carried more decimals in computing, this would have been identical with our earlier net revenue figure ($7,199).

Pasture that is worthless at the margin when no hay can be bought acquires a marginal value of $21 per acre when a market for hay is created. Simultaneously, the significance of hay grown on the farm is decreased from a marginal value of $49 per ton to $21 per ton. (The latter figure is the sum of the $16 per ton at which the hay was valued in computing net revenue and the $4.90 per ton which was the imputed value of being able to use one's own hay at $16 rather than buy hay at $20.) Note that the value assigned hay grown on the farm is now comparable with the purchase price of hay, as it should be.

This change in the relative valuation of hay and pasture reflects the different roles they play as farm organization is adapted to changing mar-

ket opportunities. The limiting role of hay in case (1) has been largely assumed by pasture in case (2), though summer labor and the availability of funds have also increased in importance.

The income imputed to funds is income in excess of provision for interest at 5% on the outlay for feeder stock. It represents an implicit interest on the remainder of the value of cash, corn and hay, plus a payment for the risk involved in devoting them to the cattle feeding venture.

How large the income imputed to funds (or any other factor) will be depends on the market opportunities for the use of funds (or any other factor). Thus one constituent of the marginal return of $0.22 per dollar of funds is the imputed value of the opportunity to convert corn into money for use in purchasing other inputs. (Since no hay was so converted the marginal value of the exchange opportunity for hay was evidently zero.) The market value of corn grown on the farm was the same in both cases, but the contribution of corn to the stock of funds had a greater value in the second case. Distinctions between the imputed marginal values of the various sources of funds could have been made by setting up the problem differently (at an increase in computing costs), but such detailed formulation was not needed in order to solve the profit maximizing problem.

Values of marginal product differ from those of traditional theory by not declining continuously as the quantity of the factor concerned increases. They remain constant until the increase in the quantity of that factor is large enough to require a change in the list of processes to be included in the optimal program. When that occurs there is a general readjustment of the marginal products of the several limited factors.

Conclusion

Recognition of the difference between the opportunity cost of inputs available on the farm and the price at which such inputs can be purchased can have a significant effect on the organization of farm activities and on the level of profit obtainable. Failure to specify correctly the market opportunities and farm alternatives available when planning a farm organization is liable to distort the resource-use pattern, while even modest improvements in market organization and information concerning market opportunities may lead to significant improvements in resource use.

SELECTION OF MAXIMUM PROFIT COMBINATIONS OF LIVESTOCK ENTERPRISES AND CROP ROTATIONS

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ADOPTION of activity analysis[1] as a tool in farm management research and farm planning has developed rapidly in recent months. Recent emphasis on the farm planning approach in extension work has added a new impetus to its development. Most programming models have treated the livestock and crop rotations separately. Hildreth and Reiter[2] developed a model to select the optimum combination of crop rotations. No consideration was given to the livestock enterprises. Swanson and Fox[3] have shown how an optimum combination of livestock enterprises may be selected with a *given* crop rotation. In this article, I present a programming model in which the livestock enterprise and crop rotation are selected simultaneously. The model thus provides a more complete and therefore more realistic approach to the use of activity analysis in farm planning. Construction of the programming model is of foremost interest but is only one step in obtaining the optimum combination of enterprises; computation problems are also of interest when models become large (as a consequence of being more realistic) and will be treated briefly at the end of this presentation.

A Model for Livestock Enterprises and Crop Rotations

Our objective is to maximize the return to labor, capital, and management[4] by an appropriate selection of the livestock enterprises and crop rotations on a 240 acre, two-man unit on Tama soils. The equation determining the returns is as follows:

$$I \text{ (maximum)} = \$449x_1 + \$223x_2 + \$218x_3 + \$199x_4 + \$227x_5 + \$239x_6 + \$116x_7 + \$116x_8 + \$68x_9 + \$17x_{10} + \$220x_{11} - \$33x_{12} - \$31x_{13} - \$26x_{14} - \$25x_{15} - \$25x_{16} - \$22x_{17} - \$20x_{18} - \$17x_{19} - \$.046x_{20} - \$.028x_{21} + \$.026x_{22} - \$8x_{23} - \$8x_{24} - \$8x_{25} + \$83x_{36} - \$93x_{37}$$

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[1] The literature has used activity analysis and linear programming to refer to the technique employed. Activity analysis seems to be the all inclusive term, whereas linear programming seems to be the more popular terminology.

[2] Clifford Hildreth and Stanley Reiter, "On the Choice of a Crop Rotation Plan," in T. C. Koopmans, *Activity Analysis of Production and Allocation*, New York: John Wiley and Sons, 1951, pp. 177-188.

[3] Earl R. Swanson and Kirk Fox, "The Selection of Livestock Enterprises by Activity Analysis," *This Journal*, 34:78-86, February 1954.

[4] Return to labor, capital, and management is maximized because no capital charges associated with the activities have been treated in the model. Other references to this quantity will be made in this article by use of the term *profit*.

Coefficients in the profit equation are the returns and costs per unit level of activity.[5]

The specifications with respect to labor supply, supplement, grain, hay, pasture days, livestock purchases, and land provide a set of relations that limit the choice of the profit maximizing combination of livestock enterprises and crop rotations.

Eleven livestock enterprises and eight crop rotations are specified in Table 1. Each column shows the man-hours of labor required in twelve labor periods and the quantity of supplement, grain, hay, pasture days, and land required (or produced) by one unit level of each activity.

Four systems (activities 1-4) of handling the hog enterprise are specified by the first four columns in Table 1: the two-litter system of hogs in which gilts farrow in March and are rebred for September farrowing; the spring litter system in which gilts farrow in March; the fall litter system in which gilts farrow in September; and the summer litter system in which gilts farrow in June.

Two systems of feeding choice, 400 pound calves are specified as activities 5 and 6. The first system of feeding assumes that calves are fed on pasture and finished in drylot. The second system assumes only drylot feeding. The feeding periods are twelve and eleven months, respectively.

Two systems of feeding choice, 650-pound yearling steers are specified as activities 7 and 8. The first system is an eleven-month feeding period on pasture; the second, a ten-month feeding period in drylot.

Feeding yearling heifers purchased September 15 and sold March 15 is activity 9.

Activities 10 and 11 are the beef-cow enterprise and the dairy enterprise, respectively.

The eight crop rotations (activities 12-19) are adapted to Tama soils of Illinois where slope does not exceed three percent. Soil conservation practices are assumed for those rotations that require erosion control practices to keep soil losses within limits of soil conservation recommendations. Costs associated with erosion practices are included in costs of production.

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[5] Price of products are based on past price relationships among grain, hogs, and cattle. Prices of grain are 1948-52 Illinois average prices. Hog prices are set at an average 12:1 hog-corn ratio. The price of 1,000-pound choice slaughter steers sold in September is 133 percent of the price of hogs sold in September and is 76.9 percent of the 1948-52 average September price of this class of cattle. 1.33 is the average ratio between 1,000-pound choice slaughter steers and 225-pound butcher hogs during the period 1944-52. The average prices of slaughter cattle for 1948-52 are adjusted by multiplying by 76.9 to construct the slaughter cattle price structure. Price margins on feeding operations are based on feeder cattle studies at the University of Illinois. Crop production costs are based on detailed cost studies made at the University of Illinois adjusted to a 1948-52 price level.

Twenty relationships are required to describe the livestock-crop complex of the individual farm. The first twelve inequalities express the relationship between the labor supply and the labor requirements of the activities. Four-hundred eighty man hours of labor are available in each labor period. No opportunity costs are attached to the labor resource of the farm as it is assumed that labor not employed by the activities will remain unemployed.

Equation (13) assures that the quantity of supplement purchased will just equal the quantity of supplement consumed by livestock. A supplement-buying activity, 20, is required in the system.

A grain-buying activity, 21 in equation (14), permits the purchase of grain above that produced by the rotations. Also, grain-selling activity, 22, permits the sale of grain in the market. The purchase and selling of grain without feeding it to livestock is prevented by having a slightly higher price on grain buying than on grain selling. Infinite activity levels for x_{21} and x_{22} as well as infinite profits would result unless a differential in the grain prices prevented it.

All grain (corn, soybeans, and oats) is converted to a corn equivalent. This necessitates only one equation for grain in the model and assumes that grain other than corn can be exchanged in the market for corn and fed to livestock. Grain coefficients of the livestock activities are also expressed as corn equivalents.

Yield estimates of crops in alternative rotations are made on the basis of high level fertilization with commercial sources of nitrogen, phosphorous, and potassium. The relationship of fertilizer produced by livestock and used by the crop rotations is discussed later.

Equation (15) states that the tons of hay consumed by livestock must equal the tons of hay produced in three haymaking periods.

Three haymaking activities permit haymaking in three periods. It is assumed that hay is harvested with a one-man baler and a crew of four men to haul and store the hay. Labor required for haying operations is furnished by the operator—see relations (5), (6), and (8)—and hired labor. Hired labor is charged at the going wage rate and included as a cost associated with the haymaking activity.

Forage produced by the crop rotations may be consumed directly by livestock or may be harvested as hay. Three pasture relations are included to describe the relations among the rotations, livestock enterprises, and haymaking activities.

Coefficients in the pasture relations for livestock activities express the number of pasture days used by a unit level of activity in each pasture period. The last terms in the pasture relations provide for the transformation of pasture days into tons of hay by the haymaking activities.

TABLE 1. RESOURCE REQUIREMENTS AND INTERMEDIATE PRODUCTS OF LIVESTOCK ENTERPRISES AND CROP ROTATIONS[a]

Relation number	Resources	Quantity	Relationship	Activity and activity levels										
				Hogs				Steer calves		Yearling steers		Yearling heifers	Beef cow	Dairy cow
				Two-litter	Spring litter	Fall litter	Summer litter	Pastured	Drylot	Pastured	Drylot			
				x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}
	Labor (hours)													
(1)	Jan. 15–Feb. 14	480	≤	4.7	1.6	3.1	2.4	1.4	1.0	1.4	.4	2.1	1.6	12.0
(2)	Feb. 15–Mar. 14	480	≤	5.9	4.2	2.7	1.5	1.4	1.0	1.4	.4	1.5	1.6	12.0
(3)	Mar. 15–Apr. 14	480	≤	5.8	4.7	1.1	1.5	1.4	1.1	1.4	1.9		2.1	12.0
(4)	Apr. 15–May 14	480	≤	4.4	2.7	1.7	4.4	1.6	1.8	1.4	1.9		2.4	10.2
(5)	May 15–June 14	480	≤	4.1	2.4	1.7	4.2	1.0	2.2	.7	1.9		1.4	8.4
(6)	June 15–July 14	480	≤	3.2	1.9	1.4	1.0	1.0	2.2	.7	1.9		.4	8.4
(7)	July 15–Aug. 14	480	≤	3.8	1.6	4.3	1.6	1.0	2.2	1.1	1.9		.4	8.4
(8)	Aug. 15–Sept. 14	480	≤	4.7	2.2	4.5	2.2	1.0	1.1	.5	1.0		.4	8.4
(9)	Sept. 15–Oct. 14	480	≤	3.5	2.2	3.4	2.0	1.0	.5			1.5	1.1	8.4
(10)	Oct. 15–Nov. 14	480	≤	2.8	1.6	2.2	1.8	1.4	1.0	.4	.2	2.1	1.6	9.0
(11)	Nov. 15–Dec. 14	480	≤	3.5	1.7	2.6	1.8	1.4	1.0	1.4	.4	2.4	1.6	10.8
(12)	Dec. 15–Jan. 14	480	≤	3.7	1.4	3.3	2.5	1.4	1.0	1.4	.4	2.4	1.6	12.0
(13)	Supplement (lbs.)	0	≤	1,189.2	464.8	816.0	464.8	192.5	372.0	180.0	240.0	165.0		220.0
(14)	Grain (lbs.)	0	≤	10,023.2	5,631.7	5,165.2	5,631.7	2,464.0	3,360.0	2,024.0	2,688.0	1,540.0	266.0	3,026.0
(15)	Hay (tons)	0	≤					.6	.9	.7	.6	.6	2.8	2.2
	Pasture periods (days)													
(16)	Apr. 15–June 14	0	≤	18.0	18.0		18.0	10.0		20.0			70.2	40.2
(17)	June 15–Aug. 14	0	≤	24.0	24.0		24.0	30.0		30.0			81.9	46.9
(18)	Aug. 15–Oct. 14	0	≤	18.0	18.0		18.0	10.0				17.0	81.9	46.9
(19)	Calves (head)	0	≤					1.0	1.0					
(20)	Land (acres)	240	≤										.7	

[a] Based on H. C. M. Case and P. E. Johnston, *Principles of Farm Management*, Appendices III and IV, Chicago; Lippincott, 1953; "Detailed Cost Report for Northwestern and Western Illinois, 1949," Department of Agricultural Economics, University of Illinois; "Fourteenth Annual Report of Feeder cattle," Farm Bureau Farm Management Service, University of Illinois; and "Farm Bureau Farm Management Service Annual Reports," University of Illinois. Yield estimates for crop rotations were made by the Department of Agronomy, University of Illinois.

TABLE 1—*Continued*

Relation number	Activities and activity levels							
	C-C-O(Cl)	C-C-Sb-O(Cl)	C-Sb-O(Cl)	C-C-Sb-O-Cl	C-C-O-Cl	C-O-Cl	C-C-O-Cl-Cl	C-O-Cl-Cl
	x_{15}	x_{16}	x_{16}	x_{18}	x	x_{17}	x_{18}	x_{19}
(1)								
(2)	.3	.3	.3	.2	.2	.2	.2	.2
(3)	.5	.6	.6	.4	.4	.3	.3	.3
(4)	.9	1.0	.9	.8	.7	.5	.5	.3
(5)	1.0	1.0	.8	.8	.8	.5	.6	.4
(6)	1.2	1.0	1.1	.8	.9	1.0	.7	.7
(7)	1.1	.8	1.0	.7	.8	.9	.6	.7
(8)	.3	.2	.2	.2	.2	.2	.2	.1
(9)	.8	.9	.7	.7	.6	.4	.5	.3
(10)	1.3	1.4	1.2	1.1	1.0	.7	.8	.5
(11)	.8	.7	.6	.6	.6	.4	.5	.3
(12)	.2	.1	.1	.1	.1	.1	.1	.1
(13)								
(14)	3,488.8	3,332.0	2,984.8	2,755.2	2,822.4	2,268.0	2,301.6	1,724.8
(15)								
(16)				12.8	15.9	21.2	26.2	37.2
(17)				13.5	16.9	22.5	31.5	39.4
(18)	10.0	7.5	10.0	11.2	14.1	18.8	29.8	32.8
(19)								
(20)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

TABLE 1—*Continued*

Relation number	Activities and activity levels							
	Supplement buying	Grain buying	Grain selling	Hay-making			Calf selling	Calf buying
				Apr. 15–June 14	June 15–Aug. 14	Aug. 15–Oct. 14		
	x_{20}	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}
(1)								
(2)								
(3)								
(4)								
(5)				1.7				
(6)					1.7			
(7)								
(8)						1.7		
(9)								
(10)								
(11)								
(12)								
(13)	1.0							
(14)		1.0	1.0					
(15)				1.0	1.0	1.0		
(16)				62.5				
(17)					62.5			
(18)						62.5		
(19)							1.0	1.0
(20)								

A calf equation provides flexibility in using 400-pound calves. Calves produced by the beef cow enterprise may be fed out in either of the calf-feeding activities or marketed directly without feeding. Calves may also be purchased and fed. The requirement imposed by equation (19) is that the number of calves raised plus the number purchased must equal the number fed plus the number sold without feeding.

X_{26} is the level of the calf-selling activity and x_{27} is the level of the calf-buying activity. Again, a price differential between the two activities is essential to prevent infinite activity levels and infinite profit. Transportation costs will generally provide sufficient differential.

The final relation states that 240 acres of land are available for the cropping system.

A MAXIMUM PROFIT COMBINATION OF LIVESTOCK ENTERPRISES AND CROP ROTATIONS

The profit maximizing combination of livestock enterprises and crop rotations for the situation specified above is as follows:

Livestock	*Number*
Two-litter system of hogs (1)	43
Calves on pasture (5)	40
Yearling steers on pasture (7)	48
Yearling heifers (drylot) (9)	23
Rotations	***Acres***
C-C-O-Cl; contoured	228
C-C-O-Cl-Cl; contoured	12
Bushels of corn equivalent sold	160.7
Hundredweight of supplement purchased	712.7

Forty-three spring litters and 43 fall litters, 40 calves fed on pasture, 48 yearling steers fed on pasture, and 23 yearling heifers fed in drylot make up the maximum profit livestock organization.

The maximum profit cropping system is a combination of rotations rather than a single rotation. No restriction was imposed to limit the choice to a single rotation. This is of interest in itself and will be discussed further.

The profit can be determined by substituting the levels of the maximum profit combination into the profit equation.

$$\$22{,}200 = \$449\,(43) + \$223\,(0) + \$218\,(0) + \$199\,(0) + \$227\,(40) + \$239\,(0) + \$116\,(48) + \$116\,(0) + \$68\,(23) + \$17\,(0) + \$220\,(0) - \$33\,(0) - \$31\,(0) - \$26\,(0) - \$25\,(228) - \$25\,(12) - \$22\,(0) - \$20\,(0) - \$17\,(0) - \$.046\,(71{,}270.6) - \$.028\,(0) + \$.026\,(8{,}996.8) - \$8\,(28.6) - \$8\,(8.8) - \$8\,(31.9) + \$83\,(0) - \$93\,(40)$$

A Combination of Rotations vs. a Single Rotation

The choice of a combination of rotations is of particular interest from the standpoint of the feasibility of the plan. The practical farm planner

might question the choice of two rotations to maximize profits because the number of fields required may not be considered desirable.

All pasture days produced by the two rotations are either used directly by livestock or converted into hay. Any reduction in the amount of hay produced by shifting to a single rotation would necessitate a reduction in the livestock program. Also, five of the twelve labor periods restricted the optimum combination. The combination of rotations required less total labor than the single rotation, C-C-O-Cl. Any change in the rotation may also affect the level of the livestock activities because more labor is required for the single rotation in the five labor restriction periods.

From the labor coefficients set forth in relations (3), (4), (7), (10) and (11) and the forage coefficients set forth in relations (16), 17), and (18), it is possible to determine whether the effective restriction in shifting 12 acres of C-C-O-Cl-Cl to C-C-O-Cl is a forage restriction or a labor re-restriction.

Any one of the four livestock activities (1, 5, 7, or 9) would need to be reduced to permit the change in the rotation. Table 2 shows the necessary changes in each activity to accomplish the change in the rotations. The

TABLE 2. EFFECTS OF SHIFTING 12 ACRES OF C-C-O-Cl-Cl TO C-C-O-Cl

	Man-hours of additional labor	Reduction of pasture days of forage	Units livestock activities must be reduced to make the shift in rotation			
			(1)	(5)	(7)	(9)
Labor periods						
Mar. 15–Apr. 14	.936					
Apr. 15–May 14	1.584				11.0	
July 15–Aug. 14	1.800			17.2		
Oct. 15–Nov. 14	.240					
Nov. 15–Dec. 14	.125					
Pasture periods						
Apr. 15–June 14		122.4				
June 15–Aug. 14		174.0	7.2			9.4
Aug. 15–Oct. 14		188.4				

two-litter system of hogs would need to be reduced 7.2 units. The effective restriction is pasture days in the second pasture period. The reduction in the number of pasture days in the second pasture period was 174 pasture days. Reducing the hog enterprise 7.2 units would provide more than enough labor in the five labor periods to meet the additional labor required by the C-C-O-Cl rotation. A second alternative is to reduce the calf-feeding enterprise by 17.2 units. The third and fourth alternatives are to reduce the yearling steer feeding enterprise or the yearling heifer feeding enterprise by 11 units and 9.4 units, respectively.

By partial budgeting each alternative of reducing the livestock enterprises to permit the rotation substitution, the net effect upon profits can be determined. Table 3 shows the reduction in profits resulting from the change in the rotation and the reduction of the livestock enterprises.

TABLE 3. CHANGES IN THE PROFITS EFFECTED BY REDUCING THE LIVESTOCK ENTERPRISES

	Livestock activities			
	1	5	7	9
Value of grain saved	$1,918	$1,119	$ 593	$383
Value of supplement saved	192	152	92	71
Reduction in returns from livestock	3,257	3,908	1,293	645
Increase in rotation cost	46	46	46	46
Value of additional grain produced	165	165	165	165
Net reduction in profits	1,028	2,518	492	71

A reduction in the yearling heifer feeding enterprise would reduce returns by only $71. It might be argued here that selecting a combination of rotations over a single rotation does not increase returns enough to justify following the combination selected by the linear programming procedure. The advantage of permitting a combination of rotations might be of more value to the research worker than to the extension worker. Permitting the solution to have a combination of rotations increases the sensitivity of the cropping system to changes in the assumptions of the livestock activities.

Fertility Program of the Cropping System

The fertility program of the farm is determined by the type and number of livestock as well as the crop rotation. Hog enterprises bring large quantities of purchased feed to the farm. Dairy and beef cow enterprises remove large quantities of forage from the rotation. The fertility interrelationships between livestock and crops are exceedingly complex. Little information is available concerning the coefficients of fertility relationships. The technique used in this model provides one possible method of introducing the fertility relationships. Rotation coefficients associated with crop yields assumed a high-level fertility program with commercial fertilization and no hay removals. When livestock are added to the organization, the fertilizer costs for each rotation must be adjusted as less commercial fertilization may be necessary or more fertilization may be necessary as a result of hay removals. Manure credits were estimated for each unit level of livestock activity based on the quantity of feed consumed and a set of assumptions concerning the return of fertilizer nutrients from feed consumed. The manure credits were added to the returns for each livestock activity.

Thus the commercial fertilizer bill can be calculated from the solution. The fertilizer maintenance costs for the program considered here were $578 for nitrogen, $1,545 for soluble phosphate, and $517 for potash.

Additional Remarks

The computations for determining the optimum combination of crop rotations and livestock enterprises were completed with a high speed electronic computor using the conventional simplex method. Thirty-nine iterations (tableaus) were performed to reach a final optimum combination. The computor time was 25 minutes.

The problem of determining adequate coefficients to describe agricultural production relationships is one of major importance in programming. Greater coordination among the agricultural economist, the agronomist, and the animal scientist may be necessary to fully realize the potential of the programming technique.

The model treated here contains 27 variables and 20 equations. This has reached the present capacity of the computor equipment at the University of Illinois. Current plans for modification of the computor should permit a greater expansion of the model.

This paper has put forth another step in the development of a relatively new tool in the field of farm management research. Several problems are still to be treated by farm management programmers. For example, nonlinear relationships should be introduced by adding vectors describing points on the nonlinear functions. In the present case, it was believed to be more important to introduce a larger number of activities and accept the linear approximations. The present model could be altered to introduce necessary refinements at the expense of a few activities. Even in its present form it has proven to be quite useful in studying returns from alternative combinations of labor, land, and management resources.

NOTES

COUNTERVAILING POWER AND AGRICULTURAL POLICY

IN HIS chapter on "The Case of Agriculture" in his *American Capitalism*, Professor Galbraith[1] has caught the historically significant point that agrarian organization in the late 19th century was largely a response to the prior growth in what he calls the "original power" of business constellations in industry, transportation, trade and finance. Similarly, Galbraith rightly argues that in the twentieth century government agricultural policies are broadly speaking an instrument of farmers' efforts to countervail against the continuing exercise of that original power. However, Galbraith goes considerably beyond this valid though none-too-original interpretation of economic history. He looks upon the application of countervailing efforts by farmers as a prime illustration of his general doctrine.

The objective of this discussion is to suggest that there is reason to doubt the efficacy of countervailing power as a solution for the modern problems of the farmer and to suggest other avenues of policy. Specifically, it is proposed to treat briefly the following three allegations contained in Galbraith's general theory as applied to the case of agriculture:

1. The exercise of countervailing power minimizes social tensions.[2]
2. As a result of the efforts of farmers to exert countervailing power, they have contemporaneously achieved an "unduly strong" position in the view of many (presumably including Dr. Galbraith), and now enjoy substantial equality.[3]
3. Countervailing power exerted directly and through government policy can be relied upon to furnish an adequate kind of program for the farmer.[4]

These points will be considered in order.

1. That intergroup tensions have been relieved on balance (this is Galbraith's substitute for neoclassical welfare criteria) is highly questionable. Examination of the contemporary controversy regarding the farm problem and program suggests that if anything intergroup conflicts have been aggravated,[5] particularly now that the roseate days of war inflation are past and the scissors are again beginning to close. Even if one were to operate with a countervalence theorem, one could not be

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[1] J. K. Galbraith, *American Capitalism: The Concept of Countervailing Power*, New York: Houghton Mifflin, 1952.

[2] J. K. Galbraith, "Countervailing Power," *American Economic Review, Vol.* XLIV, No. 2 (May, 1954), p. 3.

[3] *American Capitalism*, pp. 156, 152, respectively.

[4] *Ibid.*, pp. 169-170.

[5] Cf. David McCord Wright, "Fundamental Characteristics of the American Economy," *American Economic Review*, Vol. XLIV, No. 2 (May, 1954), pp. 26 ff.

satisfied with crude cause and effect. Each counterstroke by the farmer would evoke further action by the business sector, the original power grouping. Resort to public aid and friendly legislation on the part of nonagricultural strata throughout the entire epoch of large-scale enterprise has reinforced the power of these elements *visa vis* the farmer, thus tending to offset achievements of farm groups in this area of conflict. Each advance of one group raises the pressure (social tension) felt by the countervailing group, and requires additional exertions in order to win successes on the battlefield.

2. The whole farm movement may well be viewed as little more than a much-discussed rear guard action (except, perhaps, for a relatively small segment); and it may be questioned whether or not the lot of farm producers has been improved by the "obvious subsidy of power" which Galbraith alleges has been handed to them in the form of the government agricultural program. Does our public policy represent much more than the deference that would be accorded any articulate "sick industry"? Of course, it is a big sick industry, and one that is peculiarly blessed by a unique pattern of legislative districting[6] and a strong Congressional bloc. Nonetheless, after a quarter-century of "countervailing" farm agitation following the Civil War, one writer has said that "at the opening of the twentieth century American agriculture stood in just the same subservient position to American industrialism that the colonies had occupied toward England a century and a quarter before."[7] A half century later the quasi-colonial status of agriculture in general, and of the family and small tenant farm in particular, is still apparent. N.S.B. Gras' trenchant remark seems most appropriate, that "from protection for infant industries we have come to assistance for senescent agriculture."[8]

3. Unlike the rationalistic equilibrium of classical economics, the products of the unceasing group conflicts between original and countervailing groups are mainly and merely piecemeal attacks representing the vested interest of the particular group as seen from a perspective that does not integrate itself into the needs of other sectors. This has been the case with our agricultural program during the last twenty years. The doctrine of countervailing power, premised as it is on the pressure-group principle, offers only more of the same. Galbraith's already influential doctrine may justifiably be linked with criticism of the errors of current and past farm

[6] See the interesting discussion by E. A. Engelbert, "The Political Strategy of Agriculture," *This Journal*, Vol. XXXVI, No. 3 (August, 1954), pp. 376-377.

[7] E. G. Nourse, "Agriculture and Modern Industry," in L. B. Schmidt and E. D. Ross, *Readings in the Economic History of American Agriculture*, New York: Macmillan, 1925, p. 575.

[8] N.S.B. Gras, *A History of Agriculture*, New York: F. S. Crofts, 1946, p. 396.

programs because it is admittedly advanced as a rationale for those errors, and in effect advocates their continuance.

Is there a policy for agriculture that might circumvent the contemporary programmatic impasse? The writer would suggest a cautious affirmative.

The problem of programs appropriate to the position of particular groups in advanced industrial societies may be practically resolved if there is some one group (or unified coalition of groups) whose economic interest represents the chief factor in future economic growth. If such were the case, aspects of other particular group-interest programs could be accommodated or, where conflicting, omitted from the overall program of the "growth group." In the United States the substantial harmony between economic expansion and what is good for the private industrial investor has been a dominant tradition since the Civil War. However, in recent decades there has appeared the Keynesian criticism that capital-rich economies cannot invest privately as much as traditional consumption ratios require for full employment. This has led many to favor policy proposals which look toward publicly-induced higher consumption ratios.

The conviction of this writer is that the consumer in general, and the purchasing power of the low-income consumer in particular, is today the focal point in the determination of future stable peacetime economic growth. The strategic factor in the past may have been the rate of private investment (although its role has perhaps been exaggerated), but it is now the rate of consumption. This thesis, although not defended here,[9] must be stated in order to make sense out of the brief remarks that follow.

A high-consumption economy contains the primary requisite for the existence of a healthy agriculture. Perhaps no other major sector is so directly dependent on the rate of growth of aggregate household spending, and particularly the spending of low and middle income consumers. The potentiality for absorption of an expanded farm output in a growing high-consumption economy on the basis of (a) increased food intake of the low-income stratum, (b) increased population, and (c) a planned international program of export to economically underdeveloped and needy populations, is enormous. Furthermore, under the presumed internal conditions of stable growth, underutilized human resources in agriculture would find attractive alternative employment opportunities in the non-farm sector.

Black and Kiefer have reminded us that to date our farm program has

[9] Cf. Dudley Dillard, *The Economics of John Maynard Keynes*, New York: Prentice-Hall, 1948, pp. 325-332, *passim*.

neglected an adequate "consumption adjustment" and has focussed too heavily on securing better prices.[10] The program of the future must do more than merely allow for a "consumption adjustment," although in recommending this Black and Kiefer are moving in the right direction. An adequate program will have to be *integrated into an overall high-consumption policy* for maintaining a fully-employed and growing economy.

Possibly an agricultural program of the type advanced by Black and Kiefer could be so integrated. On the other hand, there are serious gaps in their program, not the least of which is their countervailing-power approach to the matter of setting "total prices."[11] More important, the setting of total production quotas, which in general will determine the optimum agricultural plant and population, depends on what is demanded by *the overall activity of the nonfarm economy.* The starting point is important. Beyond this, it makes an enormous difference to agriculture whether public policy emphasizes stimulation of investment, with its attendant instability, or encouragement of consumption, which may not involve such instability, and certainly is more salutary in its impact on farm income.

A high-consumption economy probably cannot be achieved without a considerable extension and integration of the existing planning work of the Federal government. The main change will have to come in the sphere of integration of programs, together with their reorientation toward the low-income consumer. The necessary accompanying production adjustments and pricing policies also probably cannot be achieved without considerably more planning in the agricultural sphere than is suggested in the Black and Kiefer quasi-laissez-faire approach.[12] We may have to face up to the necessity for some sort of solution more closely resembling the British war-time program of public purchase and resale of the aggregate agricultural product. Financing would of course have to be out of the general treasury, and based on a consumer-oriented tax (and/or borrowing) policy.

These suggestions appear to offer a hopeful alternative to the continuation of policies whose short-run, price-oriented, cartel-type measures

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[10] J. D. Black and M. E. Kiefer, *Future Food and Agricultural Policy,* New York: McGraw-Hill, 1948, p. 178.

[11] Cf. *Ibid.,* pp. 225 ff., and especially pp. 232-233.

[12] The Black and Kiefer proposals likely require a great deal more planning than is explicitly acknowledged. Frequently nominally decentralized solutions demand substantial government participation when the full implications are spelled out. Cf. also O. Heline and D. R. Kaldor, *A Framework for a Long-Range Agricultural Policy,* Washington: National Planning Association, Pamphlet No. 72, July, 1950, esp. pp. 51-54.

have not only failed to solve the farmer's economic problems, but have tended to isolate him from the sympathies of his social allies in urban communities.

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REACTIONS TO UNCERTAIN PRICE EXPECTATIONS

ON THEORETICAL grounds a certain future price for a farmer's product is more desirable to him than an uncertain future price having a most probable numerical value identical with the specified certain price. Boan has ably presented the findings of a pilot study which indicates that in fact farmers prefer the uncertain future price.[1] Unfortunately, Boan's study appears to be founded on certain assumptions with respect to interview psychology that may not be valid. These are:

1. That a farmer is likely to state his true expectations with respect to price in an unstructured interview.
2. That the certain price a farmer says he would accept is identical with the price that he would actually accept, in preference to the uncertain price he expects.

With respect to the first of these assumptions, it is quite probable that a structured depth interview conducted by a psychologist is required to elicit a farmer's true price expectations. In conditions of price uncertainty most farmers hope for prices that are considerably higher than the most probable level. Such hopes tend to become translated into expectations that lead to bitter disappointments. To escape such disappointment, many farmers try to convince themselves that their hopes are unfounded and that the most probable price is much lower than the one they really expect, even lower than the one most reasonable to expect. They may be so successful in developing this conviction that they name a low figure when asked the price they expect for their product, even though they really hope and expect the price named is too low.

If the psychological hypothesis presented above is valid, Boan's "pessimists" probably all named prices much lower than those they really expected. Then, of course, certain prices equal to or less than the amount they named were most unattractive to them. Boan does not tell us anything about the "neutrals" and "optimists" of his survey but we have greater reason to expect that they would be willing to accept a certain price equal to or less than the one they named. Probably their true price expectations were no more optimistic than those of the "pessimists."

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[1] J. A. Boan, "A Study of Farmers' Reactions to Uncertain Price Expectations," *This Journal*, Volume XXXVII, No. 1, February 1955, pp. 90-95.

With respect to the second assumption, the only sure way to determine the minimum certain future price a farmer would accept for his produce would be to bargain on the basis of a binding contract to buy the produce at the price stated. Then, the farmer would sit down and sort out hopes, true expectations, and sham expectations, and make his decision accordingly.

We are extremely doubtful that questions concerning a hypothetical certain price can ever elicit this decision. The interviewee probably will not exert the effort necessary for decision making in the absence of the need for a decision.

Considerable doubt thus exists as to the likelihood of obtaining reliable answers on either price expectations or minimum acceptable certain prices in unstructured interviews, such as Boan apparently used. A psychologist skilled in depth interviewing could undoubtedly penetrate and analyze the complex of hopes, true expectations and sham expectations making up a farmer's "true price expectations" under conditions of uncertainty. Such interviewing also might cast light on what weight, if any, can be attached to farmers' statements of their willingness to accept specified prices. Progress in empirical research on responses to uncertainty appears to hinge on making use of the techniques of the psychologist as well as those of the economist.

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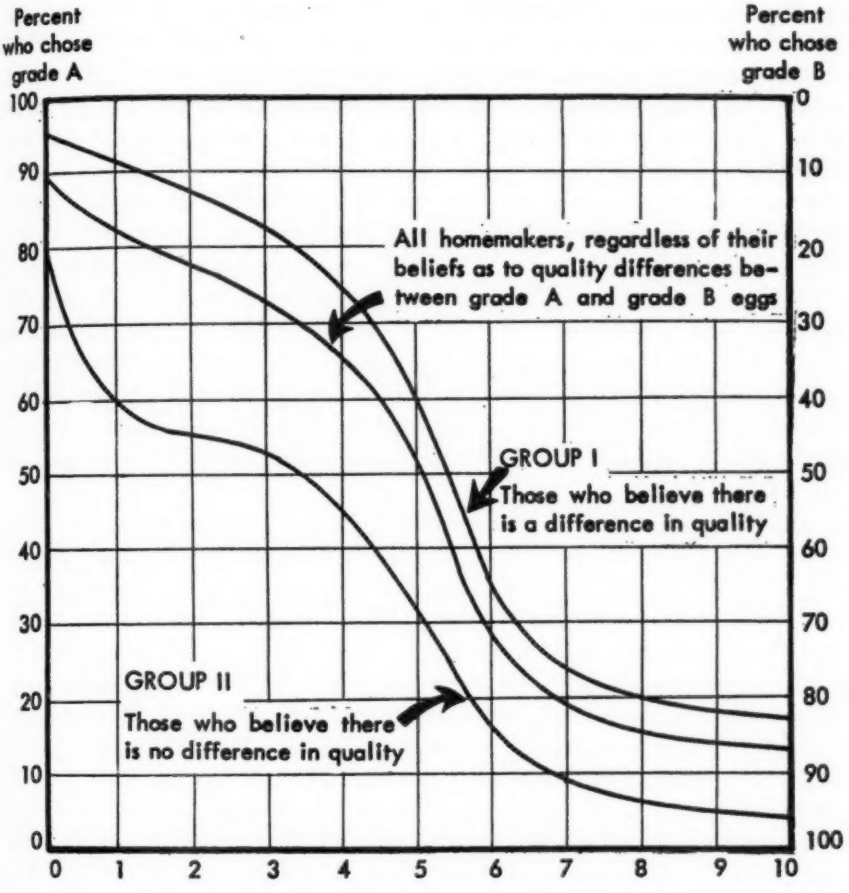
OGIVE CURVES IN A DEMAND ANALYSIS*

AN OGIVE curve is a useful device in analysis of demand, both in case of the demand schedule for a single commodity and the substitution of one commodity for another. Two ogive curves can mark off an estimating zone for two competing commodities that will allow for variations in the consumer universe under various supply conditions.

In a West Virginia study, 4,570 homemakers gave opinions on the market value and the physical differences between grade A and grade B eggs. Some of the results are shown in the accompanying figure. About 70 percent (Group I) stated that they believe there is a quality difference between grade A and grade B eggs while 28 percent (Group II) stated that they believe there is no difference in the quality of the two grades. Logically one would not expect these two groups to be willing to pay the same price premium for grade A over grade B.

* Approved by the Director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 508.

Perhaps the currently most orthodox statistical treatment that would be given these data would be to test, by analyzing the variance and the difference between the two means, to see whether or not the two groups are distinctly different; and, if so, by how much. This would generalize



RESPONSES OF HOMEMAKER GROUPS TO VARIOUS PRICE PREMIUMS OF GRADE A OVER GRADE B EGGS.

the difference over the whole range of relative sales (or disposable supplies) of grade A and grade B eggs. Because the estimating zone between the two ogive curves is not of uniform width, the difference derived in this manner would strictly apply only to equal supplies of the two grades. This generalized method thus becomes unrealistic for day-to-day deci-

sions that must be based on a varying supply relationship and a consumer response dependent upon this relationship.

The egg retailer could use the accompanying figure to advantage. Assume that the retailer wants to charge 5 cents more for grade A than for grade B eggs. If he deems his customers are normally responsive to egg quality, he would use the middle curve in the figure and order about half of each grade. If he thinks his patrons are heavily "sold" on the quality difference he would use the Group I curve and order about 60 percent grade A and 40 percent grade B, but if he thinks his patrons believe there is no difference in the quality of grade A and grade B eggs, he would order only about 30 percent grade A. His best estimate should fall within the range of 30 percent of grade A and 60 percent of grade B. These percentages, or relationship between the percentages, hold only for this particular price difference between the two grades. At a 6-cent difference there would be a range from about 15 percent grade A to about 35 percent grade A and at a 4-cent difference the range would be from 43 percent grade A to 73 percent grade A. The relationship between the two consumer groups cannot be generalized in a simple manner because it depends on the price differential assumed. This analysis postulates a fixed premium for grade A and shows the relative volume of sales of the two grades.

Another problem of equal importance is to determine what price premium would sell various relative supplies concurrently. If a retailer has an egg supply of 60 percent grade A and 40 percent grade B for example, he could expect only a 1-cent difference from Group II but a 5-cent difference from Group I. If his egg supply were made up of 30 percent of grade A and 70 percent grade B, he could expect a 5-cent difference from Group II compared with a 6-cent difference from Group I. The range in the price difference between the two groups is about 5 times as great when 60 percent of the eggs are grade A as when 30 percent are grade A. In this case with supply given, the two consumer groups are nearer each other in their judgment when about one-third of the eggs are in the grade A class and, within practical limits, the difference widens in both directions from this.

The ogive curves provide a basis for detailed comparisons. The initial 1-cent premium on grade A eggs, for example, will shift about one-fourth of the homemakers in Group II out of the grade A market (grade A sales decreasing from 80 percent to less than 60) whereas the initial 1-cent premium would shift less than 5 percent of the homemakers in Group I. Actually it would take more than a 4-cent premium to shift one-fourth of the Group I homemakers out of the grade A market.

Certain problems in either analysis or presentation could be expedited

and clarified by using ogive curves. Some of the harm being done by presenting data in such generalized form that they are interpreted as static relationships, whereas in reality they are dynamic, could be avoided by depicting some of the gradient relationships in graphic form. The ogive curve is easily understood by lay people and an estimating zone between two ogive curves should present no great difficulty. This method fits certain demand analyses very well. It probably would fit many socio-economic analyses in which intensity of response varies in relation to two other factors—one of them being based on the changing make-up of the responding universe.

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ADJUSTING FOR CHANGES IN PRICE LEVELS IN VALUE PRODUCTIVITY STUDIES*

THIS article presents a technique for adjusting value productivity estimates derived from "Cobb-Douglas functions" for changes in input and product prices. Such estimates have usually been derived from data covering a single calendar year and tend to be valid only for that period. Consequently, expensive annual surveys have been required to keep such estimates current. Although there are many mathematical functions useful in production function studies, this note demonstrates the adjustment technique using a one input "Cobb-Douglas function," $Y=aX_1^{b_1}$.

If physical productivity functions were available, the problem of adjusting marginal value productivity estimates to conditions of changing price would not exist. All that would be required would be to multiply the marginal physical product of X_1 by the product price. In much empirical work in farm management, however, it is impossible to employ physical units of measurement. Limited resources and the additional problem of high simple correlations among input categories in "Cobb-Douglas" analyses are usually met by the categorization of inputs into groups that do not have common physical units. As a result, monetary units are usually employed to measure input and investment categories of considerable physical heterogeneity.

In the event that physical production functions have not been derived, the problem of adjusting marginal value productivity estimates to price changes becomes more complex. The usual method of comparing the

* Journal article, Michigan Agricultural Experiment Station. This article is based on the author's M.S. Thesis carried out under Project 442.

prices of groups of commodities from one period to another involves a price index. The present problem limits the choice of index to one that requires only base year weights, since non-base year weights would necessitate the additional surveys that we are trying to avoid. One of the best known methods of computing a price index that meets the foregoing condition is Laspeyre's which takes the form $I = \frac{\sum(P_nQ_0)}{\sum(P_0Q_0)}$ or its equivalent $I = \frac{\sum\left[\frac{P_n}{P_0}(P_0Q_0)\right]}{\sum(P_0Q_0)}$ where I is a price index, P is price, Q is quantity, and o and n base and non-base periods respectively.

The value productivity of a dollar of input category X_1 in the production of Y depends in part on the prices of X_1 and Y. If the price of Y rises or the price of X_1 falls, the value productivity of a dollar of X_1 rises. The converse is true if the price of Y falls and/or the price of X_1 rises. A simultaneous rise or fall in the prices of X_1 and Y requires a quantitative analysis to determine its direction.

A one input "Cobb-Douglas" function, $Y = aX_1^{b_1}$ will be considered. Y is product measured in dollars, X_1 is an input category measured in dollars and I_{x_1} and I_y are price indexes of X_1 and Y respectively such that $I = \frac{\sum(P_nQ_0)}{\sum(P_0Q_0)}$.

The conditions for adjusting the marginal value productivity of X_1, as prices of categories X_1 and Y vary from period "o" to period "n" may be developed as follows:

$$Y_{(t=n)} = I_y \cdot a \frac{[X_{1(t=n)}]^{b_1}}{I_{x_{1(t=n)}}} = Y_{(t=0)} \cdot I_y$$

$$MVP_{x_{1(t=n)}} = \frac{dY_{(t=n)}}{dX_{1(t=n)}} = I_y b_1 a \frac{[X_{1(t=n)}]^{b_1-1}}{I_{x_{1(t=n)}{}^{b_1}}}$$

$$= I_y b_1 a \frac{[X_{1(t=n)}]^{b_1-1}}{I_{x_1}} \cdot \frac{X_{1(t=n)}}{X_{1(t=n)}}$$

$$= I_y b_1 a = \frac{[X_{1(t=n)}]^{b_1}}{I_{x_1} b_1 \cdot X_{1(t=n)}}$$

but since $$\frac{X_{1(t=n)}}{I_{x_1}} = X_{1(t=0)}$$

then $$MVP_{x_{1(t=n)}} = \frac{dY_{(t=n)}}{dX_{1(t=n)}} = I_y b_1 a \frac{[X_{1(t=0)}]^{b_1}}{X_{1(t=0)} \cdot I_{x_1}} \quad 1$$

which result may be interpreted as meaning that the marginal value productivity of a dollar of X_1 in period "n" in the production of dollars of Y is equal to the marginal value productivity of a dollar of X_1 in the base

period multiplied by the ratio of I_y to I_{x_i}, provided that the physical organization has not changed between the periods.

It should be noted that equation I may be extended to include more variable inputs as follows:

$$MVP_{x_{i(t=n)}} = I_y \cdot \frac{b_i E(Y)_{(t=0)}}{X_{i(t=0)} \cdot I_{x_i}}$$

where

$$E(Y)_{(t=0)} = a \frac{[X_{i(t=n)}]^{b_i}}{I_{x_i}} \cdots \frac{[X_{i(t=n)}]^{b_i}}{I_{x_i}}$$

and

$$X_{i(t=0)} = \frac{X_{i(t=n)}}{I_x}$$

Theoretical and Empirical Considerations

One difficulty in using Laspeyre's method of index number construction in the foregoing theoretical development arises from the biases present in the index. Considering the adjusted MVP estimate of $X_{1\ (t=n)}$ in the form $I_y \cdot \frac{b_i E(Y)_{(t=0)}}{X_{i\ (t=0)} I_{x_i}}$. It may be seen that both indices tend to bias the MVP estimates downward. For the factor prices index (I_{x_i}) there tends to be an upward bias since firms will tend to buy less of those factors that have risen relatively in price. For product price indexes (I_y) the bias is downward, in that firms will tend to produce less of those products that have fallen in price and more of those that have risen relatively in price. (This problem would be important if other than close substitutes and close complements were not included in the same category.) The rules for categorization outlined by Johnson[1] insure that close complements and close substitutes are included in the same category with sets of close complements being handled as single inputs and close substitutes being priced in terms of their least common denominator. Compliance with these rules probably reduces inter-category adjustments resulting from price changes to a level with which one can live.

An Empirical Application

The adjustment technique was used empirically on a "Cobb-Douglas function" fitted to data collected from thirty selected Michigan farms for the year 1952. The following MVP estimates were derived:

1. 1952 MVP's at the "usual" farm organization during 1952.
2. 1953 MVP's at the "usual" farm organization during 1953.

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[1] Lawrence A. Bradford and Glenn L. Johnson, *Farm Management Analysis*, New York: John Wiley & Sons, 1953, pp. 144-146.

These estimates are as follows:

	MVP estimate 1952	MVP estimate (adjusted for 1953 prices)
land (per acre)	$ 9.05	$ 7.68
labor (per man month)	15.10	12.80
machinery (per dollar invested)	.402	.339
livestock-forage (per dollar invested)	.121	.121
cash expenses (per dollar)	.859	.724
animal units of housing capacity (per unit)	68.60	58.20

The 1953 estimates, with their associated marginal factor costs, may be used to recommend adjustments to be made in the farm organization for the next period considerably in advance of record analysis.

Conclusions

1. The technique developed for adjusting marginal value productivity estimates for price changes is easy to use and of moderate cost. Adjustment by this technique would provide estimates at less than one percent of the outlay required to collect and process annual farm data.
2. Intra- and inter-category adjustments due to price changes are adequately handled in the analytical and computational procedures developed.
3. Estimates of value productivity may be made soon enough to be of value in planning for the next period.
4. The operational time span between base and non-base periods would be limited by technological and institutional changes that would tend to change the physical productivity functions.

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FURTHER COMMENT ON THE HEADY-PESEK FERTILIZER PRODUCTION FUNCTION

JUDGING from their reply,[1] Heady and Pesek apparently misunderstood certain points raised in our criticism[2] of their article on a fertilizer production function.[3] In the hope of clarifying our position, I will attempt to recapitulate the more relevant points.

1. We did not in our criticism advocate any particular research procedure, although Heady and Pesek in their reply refer to the single variable experiments

[1] Earl O. Heady and John Pesek, "Hutton and Thorne on Isoclines: A Reply," *this Journal*, May 1955, pp. 363-68.

[2] R. F. Hutton and D. W. Thorne, "Review Notes on the Heady-Pesek Fertilizer Production Surface," *this Journal*, February 1955, pp. 117-19.

[3] Earl O. Heady and John Pesek, "A Fertilizer Production Surface," *this Journal*, August 1954, pp. 466-82.

as the "Hutton and Thorne approach." We reasoned from a hypothetical single variable experiment in criticism of their proposal but this was only a matter of convenience. The purpose was to demonstrate that there existed the possibility of a more effective way of doing research in this area than the procedure they proposed. We did not say that there was not a better means of doing the research than the single variable experiment. Our view was that the question of the best method is yet to be resolved. We called into question what we considered to be a premature conclusion by Heady and Pesek on this point.

In their reply Heady and Pesek make such statements as ". . . our system is more practical. . . ." "Ours is the more economical experimental system . . ," and ". . . it [the method proposed] would be much more productive. . . ." These statements illustrate what we viewed as premature conclusions in the original article.

2. Our criticisms were cast in terms of the original article. We could have drawn logical inferences from their presentation and cast our criticism in terms of such inferences but this appeared to us as unnecessary. We demonstrated that the procedure they proposed was vulnerable to criticism in the application they made of the results. Therefore, the general vulnerability of the procedure to criticism seemed amply established.

3. We did not in any sense imply that their one year's results could be used for practical recommendation. It appears that this is obvious, the tone of the Heady-Pesek reply to the contrary.

4. We did not call into question the statistical significance of interaction between fertilizer nutrients for the whole range of observations. Our criticism was in terms of the economic significance of interaction over the portion of the fertilizer production surface explored by Heady and Pesek. We recognized that the interaction may vary from one portion of the surface to another and amply qualified our statement to that effect.

By way of response to certain points raised in the Heady-Pesek reply I wish to make the following observations:

1. Heady and Pesek's comparison of the optimum treatment indicated by their production function with the optimum treatment inferred from single variable experiments is biased in favor of their procedure. Without advocating the single variable procedure, it is fair to say that such experiments are usually planned to give recommendations for treatments for a rather limited range of yields. Thus, single variable experiments designed to give answers for the 100-125 bushel range usually would not be relied upon to answer the questions of treatment for the 50-80 bushel range. If, as Heady and Pesek indicate, the farmers of the area are generally interested in the lower range of yield, then the single variable experiments would likely be designed for this lower range.

2. The appropriate test of the two procedures would be an empirical one in which the Heady-Pesek approach would be compared with the single variable approach where the treatments were designed by the agronomists to give answers for particular situations. Contrary to the tone of the Heady-Pesek article and reply the outcome of such a test is far from obvious. Heady and Pesek's reply is misleading in its implication that the data obtained in single variable trials could not be used in fitting a production surface. It is true that trials conducted in different years will be subject to between years variation, but, since all procedures require more than one year's data, Heady and Pesek must deal

with this variability also. Since they reported upon only one year's results this difficulty was not apparent in their reports.

3. As was generally characteristic of their original article, Heady and Pesek do not present enough data in connection with their alfalfa isocline map to permit adequate criticism. Certainly some indications of yield levels are needed in this instance for proper appraisal. Yields could have been reported as isoquants on the map of the isoclines without requiring additional space.

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World Population and Food Supplies, E. John Russell, London: Allen and Unwin Ltd. (New York: Macmillan Company), 1954. Pp. 513, illus. $8.50.

Perhaps this reviewer has too much affection and respect for Sir E. John Russell to be entirely objective about his new book. Yet certainly all those concerned with the potential abundance within the soils of the world are fortunate indeed that an agricultural scholar of such eminence has addressed himself to this great problem of our generation.

During a long life Sir John has studied the agriculture of his own British Isles and of Western Europe with great intensity. He has perhaps traveled more widely than any other agriculturist of comparable stature. He has seen the world in terms of the experimental results at the Rothamsted Experimental Station, of which he was the distinguished director for many years.

This book is primarily about agriculture. Relatively, both soils and population are treated lightly. His view is primarily that of the present. "The most hopeful way of increasing food supplies," he writes, "is by more intensive cultivation of the land already in use: This is true not only for the United Kingdom, but for large parts of the rest of the world." This somewhat British outlook is emphasized even more when he writes, "In all well-farmed countries the livestock population is high . . ." After all, Sir John himself has seen splendid tropical farming without livestock. Nor should the bush fallow of the humid tropics give way to the traditional grass leys of Britain, at least not until we know much more about fertilizing and protecting tropical soils than we do now.

For the countries that Sir John has visited, mainly those of Western Europe and of the British Commonwealth and its dependencies, a detailed description of the agriculture is given, based upon FAO statistics, many other published reports, mainly British, and his own copious notebooks. Since his travels occurred at various times over a long life, some notes are more up to date than others. For example, it is doubtful that France has quite maintained the high-quality agricultural research services that Sir John understood so well in former years. His descriptions deal with the minutiae of plant varieties, plant and animal diseases, field layouts, insect hazards, fertilizer use, and the other parts of going farms; although the broad situation in each country is made fairly clear. After all, most agricultural production is the responsibility of millions of small producers to whom these minutiae are of critical importance.

He does not speculate much about possible new scientific achieve-

ments, which are unpredictable. "I have refrained from doing so," he says, "because the majority of food producers are small operators with neither the time, the money, nor the knowledge for making drastic changes. Improvements can come only slowly; already the better farmers in many countries are adopting them and our hope must be that the others will follow. Advanced countries able and willing to pay for food will, so far as I can see, always get it." This reviewer agrees with his generalization, with some reservations about the last sentence.

Sir John summarizes his views on the United States briefly, not because he does not understand our agriculture well, but to save space. He fully recognizes the importance to other farmers in the world of the efficient methods developed in this country. The reader is given references to basic sources.

Other countries outside of Europe and the Commonwealth are treated more lightly. The Soviet Union and other parts of Asia, except for India and Pakistan, are treated briefly in somewhat general terms. So are most parts of non-British Africa.

Although Sir John regards South America as having great potential agricultural resources—even greater than Africa—he gives it only a 20-page chapter of which Brazil and Argentina get most of the space, compared with 28 pages for Australia and 13 for little Denmark.

For the countries covered in some detail, the book gives the reader a most useful picture of the agriculture, of both the successes and the difficulties. His descriptions are veritable mines of information, all related to the central theme of food production by ordinary farmers.

Sir John fails to give us, however, a specific summary of the world situation as a whole. The general view that seems to emerge is one of a world that has the potential for producing enough food for its growing population. He realizes that soil and population are poorly distributed in respect to one another. Agricultural research is inadequately supported to meet the challenge, especially in most tropical countries. Even where the facts are available for good recommendations the people are often ill-prepared to accept them because of deficiencies in education, outmoded tenure arrangements, inadequate political leadership, and many other social, economic, and institutional limitations. He points to the failures of grandiose, "quicky" schemes like the groundnut scheme in East Africa, the poultry scheme in the Gambia, and the one for grain sorghum and pig meat on the Peak Down of Central Queensland.

He emphasizes the interference to orderly agricultural progress of drastic changes in social organizations: "The new factors that have come into play destroying for a time the older hopes of progress have been

the material destruction and widespread impoverishment resulting from the war, and the social upheavals which in so many countries have hampered food production. Political theory, especially nationalism, has in many countries become almost an obsession, sweeping aside laws of economics and other considerations and setting up national systems which will almost certainly result in a lower standard of living and which can be maintained only by skillful propaganda backed by force."

Sir John's restrained view of the Tropics, especially in Africa, is probably due in part to the great contrast between the current practices in tropical Africa, including the widespread use of the bush fallow, and the agriculture that he knows and understands so well in England. He is not able to see around the great difficulties. He emphasizes them. One can only hope that many Americans and Western Europeans, agriculturists and administrators alike, take to heart his thoughtful admonition: "The problem in Africa is to convert the peasant agriculture into a better system capable of giving increasing output as the need increases. Difficult technical and scientific problems are involved which are not yet solved, and which require for their solution highly skilled investigators left to work in peace and security. They cannot be adequately dealt with by visiting experts remaining for a few months only, but with no permanent interest in the country; nor could they be solved by people who have merely learned something at a college and got a degree. Scientific acumen of a high order is needed; it cannot be imparted but only developed in those in whom it is inborn. Such men can only be attracted, not produced." This reviewer has seen no clearer statement on the present needs in the Tropics. And it applies to other agricultural regions as well.

The book suffers from a lack of maps. Although a great traveler, Sir John does not use maps to help make his observations geographically quantitative. Without maps, for example, his excellent discussion of the Irish Republic can be understood clearly only by those like himself who have a picture of the country from first-hand experience. The author reports on the results of a great many experimental trials and reclamation schemes, and he emphasizes many regional contrasts. Yet the significance of these cannot be fully appreciated without soil maps. In his discussion of the United Kingdom, which he knows so well, he emphasizes the great variability in soils and in other growing conditions! Now of course similarly detailed studies disclose like complexities in most other parts of the world, and even greater ones in the Tropics.

Sir John explains the development of practical erosion control within farming systems following the earlier, what he calls, "very alarmist reports." His own observations and suggestions are those of a balanced

agriculturist. Yet, curiously, he refers his readers to *The Rape of the Earth,* a book even more "alarmist" than its gentle title suggests.

But enough about faults. Sir John has written a solid book, giving the relevant facts as a wise man sees them, without run-away emotion and with no attempt at glamour or to scare. No student of world agriculture should miss reading it.

Such students will find this book especially rewarding for its emphasis upon detail. It makes abundantly clear why and how useful plans for improvement in the food situation are both extremely complicated and highly technical. An optimistic view emerges *if* one is optimistic about a more solidly built and a more scholarly agricultural research program; and if one takes the long view. For the short-run, of course, most progress can be expected in temperate areas where some research is now under way and where modern industry is equipped to supply modern farmers. With governmental policies to support the work of dedicated agriculturists, both skilled research scientists and patient advisers, a long view can be optimistic too. Otherwise not.

CHARLES E. KELLOGG

Soil Conservation Service

The Location of Agricultural Production, Edgar S. Dunn, Jr., Gainesville: The University of Florida Press, 1954. Pp. 115. paper, $2.50; cloth, $3.50.

Although the general theory of a location and space economy is basically concerned with geographical flows, the space factor to a large extent has been set aside or ignored. This may be due in part to the economic theorists persistent concern with the time variable. It is, highly desirable, therefore, that a book should appear directed toward a conceptual model that would permit the space factor to enter the analysis as an explicit variable, and that would allow for variation in the spatial extent of production for each firm and in the geographic pattern of production and resource use.

In his book on *The Location of Agricultural Production,* Dunn has attempted to introduce space into the conventional equilibrium statement and to integrate the contributions of such past leading spatial theorists as Thünen, Weber, Brinkman and Lösch into one discipline. The specific goals delineated are: (1) ". . . to establish the fact that the spatial orientation of production is an inseparable part of the solution of the total economic problem. We seek to formalize the equilibrium system for the agricultural segment of the economy and include an explicit consideration of space as a variable." and (2) ". . . to provide a general framework of analysis that will serve the dual function of aiding in the

evaluation of existing techniques in the field of agricultural economics and suggesting new approaches to the study of agricultural phenomena." (p. 93).

The first seventy pages of the book are devoted to an explanation of the spatial structure of agriculture on a static equilibrium basis. Thus variables such as technology, transport structure and population are considered as predetermined and these factors through their interrelationship in an equilibrium system are used to explain land use patterns. The equilibrium statement is concerned with the location of all agricultural products and thus attention is devoted to the competition of uses that takes place on an industry basis. Rent serves as the production authority that issues location priorities. Chapter one is devoted to the problems in the field of location and the tenets of an ideal conceptual framework in this field. Chapter two gives attention to the influence of the distance factor upon the distribution of land use patterns in agriculture and elaborates on the well known Thünen model. Chapter three is given over to the influence of the firm equilibrium upon the marginal rent functions for the industry. By means of logic the author demonstrates how a non-linear rent function may be generated when the transport rate structure is considered as variable over space. Chapters four and five summarize the modifications on the spatial equilibrium statement for the cases of the multiple product firm, multiple markets and varying production possibilities of land.

The last section of the book is concerned with the realization that a theory of location must also introduce dynamic factors into the analysis, which will account for the modification of time. By means of comparative statics, attention is devoted to such dynamic factors as population, income, technological innovations, and transport costs, which lead to a process of change in a regional economy. The final chapter of the book is devoted to a brief discussion of the relationship between agricultural and industrial production and a reflection by the author on his work and its possible shortcomings. Included in the appendix is a cursory review of the conclusions of Thünen, Brinkman and Lösch in regard to location analysis.

Despite the productive efforts of the author and earlier spatial theorists the goal of constructing an operational model of a location and space economy has not been achieved. The author fully realizes this and makes no pretense that the model developed is capable of direct application to the solution of location problems. The reviewer is somewhat regretful that the author did not discuss the recent contributions of Leontief, Koopmans, Samuelson and others relative to the new techniques for handling spatial equilibrium problems. This is perhaps out-

side of the scope of the book but it would have left the reader with some hope of analyzing spatial equilibrium problems.

This book should prove of interest to many agricultural economists, because it makes available an integrated development of the principles of economic location as related to agriculture. As such, it will fill a gap in the literature of economic location and regional analysis.

GEORGE G. JUDGE

Oklahoma A. and M. College

Economic Trends in Agriculture, V. R. Wertz, Ann Arbor: J. W. Edwards, Inc., 1954. Pp. x, 409. $4.50.

This book grew out of a course offered by the author to freshmen and sophomores in agriculture at Ohio State University that was designed to give the student something of an economic background before he pursued courses in principles of economics. The sequence in the book is based upon the belief that the student will get more out of principles if he has had a course in "economic trends" covering his own area of specialization. Many would doubt the relative value of such courses, as represented by the content of this book, in view of the problem of allocating the student's time to the most productive uses. It can be argued that instead of asking the student to take a course essentially devoid of any clear discussion of economic principles he could better use that time studying economic principles with applications to agriculture. There is no universal agreement on this and Professor Wertz gives the profession his view that such courses are worthwhile and that most texts are aimed too high.

In an effort to keep the content understandable in everyday readable language, Professor Wertz uses statistical data freely without much analysis. Considerable attention is given to the description of the details of table and chart making and to the use of historical data and charts to portray the trends in agricultural production in the world and the United States. Following this, the author devotes a chapter to trends in consumption and a very brief and inadequate chapter to distribution of products from the farmer to the consumer.

The principal strength of the book lies in the four chapters devoted to price trends. This section deals in a very general way with a wide variety of topics such as index of wholesale prices, effects of general price changes on individuals, index of prices received and paid by farmers, price policy, land prices and the determination of the value of land. Agricultural credit is discussed almost entirely with respect to federally sponsored agencies. To round the book out, Professor Wertz de-

votes a chapter each to foreign trade and to taxation, and then closes with a pertinent question, "how much government do we want?"

Professor Wertz's efforts to keep the content "down to earth" led to the book's most serious weakness; that it is not on a high enough level to give college students any perspective about the role of principles in the study of economic problems of agriculture. Perhaps, it would be better suited for high school students. Thus, it seems to the reviewer that if this book is used as a college text, the instructor would have to rely upon his own initiative to cast these topics in a framework of economic principles.

JOHN C. REDMAN

University of Kentucky

Long-Range Economic Projection, Studies in Income and Wealth, Volume Sixteen, National Bureau of Economic Research. Princeton: Princeton University Press, 1954. Pp. x, 478. $9.00.

"Projections in Agriculture" by James P. Cavin, pp. 107-130, and "Some Considerations in Appraising the Long-Run Prospects for Agriculture" by Rex F. Daly, pp. 131-189, discussed in this review.

There is a great need for information of the type provided in these studies in long-range economic projection. Although the projections cannot be measured by a yardstick borrowed from the greener pastures of the experimental scientists, comparative results are given for some of the projections that have run the course of time. These will be pointed out in connection with a brief summary of the two papers on agriculture discussed in this review.

James P. Cavin reviews two studies of economic projections made by the Bureau of Agricultural Economics for the postwar period. The first of the studies consists of four reports, under the general title of *What Peace Can Mean to American Farmers*, published in 1945.[1] The study was done in 1944; the projections were for the year 1950. The other long-range study, published in 1948, usually called the Hope Report, since it was prepared at the request of the Hon. Clifford Hope, was *A Study of Selected Trends and Factors Relating to the Long-Run Prospect for American Agriculture*. The analysis was done in 1947 and the projections were for a postwar period described as being about 1955-65, with some selected trends projected to 1975.

[1] Department of Agriculture, Misc. Pub. 562, May 1945; 570, July 1945; 582, October 1945; 589, December 1945.

The first of the reports on *What Peace Can Mean to American Farmers* (the only one of the four discussed by Cavin) was intended primarily to be educational. The estimates were not intended as forecasts of what would happen after the war, but were made to illustrate what was probable under stated alternative assumptions with respect to employment, price levels, productivity of labor, and related factors. The three assumed conditions regarding employment were (1) full employment (2 million unemployed), (2) intermediate employment (7 million unemployed), and (3) serious depression (17 million unemployed). Further assumptions were that there would be no support-price or production control programs (except the sugar quota system), that exports would revert to approximately the pre-war pattern and that high levels of employment would prevail in the principal industrial countries of the world.

Under the assumption of full employment, cash income from farm marketings was estimated at 17 billion dollars in the projection for 1950 unadjusted for changes in the general price level, as compared with 23.6 billion dollars under the adjustment for an assumed 1950 price level. Cash income from farm marketings actually was 27.5 billion dollars (on basis of the second and third quarters) in 1950. The projected level of food consumption per capita was too high; a projection of 118 was made for 1950 as compared with an actual index of 112, based on 1935-39 equal to 100.

Unlike the projections in *What Peace Can Mean to American Farmers,* wherein no attempt was made to determine which of the alternative situations projected for 1950 was likely to prevail, the Hope Report was based primarily on the trends selected as likely to be predominating over the next 25 years. These trends indicated a relatively high level of employment and a relatively good prospect for American agriculture. Besides the high or most probable level, average and depression levels of employment were also analyzed. Cavin reports that this was partly in deference to a number of agricultural economists who were much less optimistic than others in the BAE about the long-run economic prospects for agriculture.

The BAE made a number of recalculations assuming a considerably larger population and a somewhat higher level of total farm output and of prices generally than was assumed in the Hope Report. These recalculations according to Cavin appear to justify more fully the projections of the relatively high level of farm prices and incomes made in the Report. As compared with an average parity ratio of 120 for prices received by farmers to prices paid in 1947, a parity ratio of 100 was established in the Hope Report for a situation of high employment in 1955-65. As com-

pared with cash receipts from farm marketings of 30 billion dollars in 1947, an estimated 23 billion dollars would accrue to farm marketings for a situation of high employment in 1955-65.

The paper by Rex F. Daly includes a set of projections for the economy centering on 1970, in which he casts an appraisal of the long-range prospects for agriculture. Specific objectives include projections for population, labor force, productivity, total output, the price level, and the relative position of agriculture, i.e. the demand for farm products, farm output, imports and exports, farm income, prices received for major farm products, and prices paid for products used by farmers. Past relationships and trends in economic, social, and political conditions provide the basis for appraising the future. The methodology is primarily historical. Although the long-run growth rates and the general inertia of behavior patterns of individuals over time provide much of the foundation for the framework of the projections, many empirical measurements and statistical analyses were used.

One of the major assumptions used by Daly is that the economy is expected to grow during the next few decades, much as it has in recent decades. Wartime conditions or long periods of semi-mobilization resulting in continued inflationary pressure are not assumed, but the government will be partly effective in its counter-cyclical measures to maintain full employment and prevent deflations of the magnitude of the depression of the 1930's.

Total demand for farm products during the next quarter century is expected to depend chiefly upon population growth and changes in per capita real income. Since aggregate farm products have a relatively low price and income elasticity, increases in total utilization per person are expected to be small regardless of possible higher incomes or lower prices. The pattern of consumption probably will be characterized by less grain and potatoes and more fruits, vegetables, and livestock products.

Although little change occurred in total crop acreage harvested during the last four decades, land used for food increased by approximately 100 million acres, or about 50 percent. About 65 million acres of the gain was from substitution of machine power for horse power. Increased production of food and fiber during the next several decades must come largely from more intensive use of land rather than from increased cropland. This means greater capital inputs and continued innovation.

Projected utilization of farm products by 1970 shows a level about one-fourth larger than the relatively high 1945-49 average. Although the level of foreign trading may be large, net exports are expected to be small. The supply response to an expansion in total demand will greatly determine relative prices for farm products. If past growth in farm output is indica-

tive of what can be expected in the future, projected demand for farm products suggests relatively favorable terms of trade for agriculture. If, on the other hand, domestic economic activity recedes and export demand weakens, the recent rapid expansion in farm output is expected to contribute to surpluses of farm products.

ROBERT L. TONTZ

Oklahoma A. and M. College

Contemporary Readings in Agricultural Economics, edited by Harold G. Halcrow, New York, Prentice-Hall Inc., 1955. Pp. xix, 411. $3.95.

In the preface to this volume Professor Halcrow says that "the theory of the anthology—the guiding light for the editor in his task of selecting and editing—is not fully developed." I suspect that this is an understatement; I suspect that there is no useful theory to guide the editor in this area. The criteria for selecting pieces of writing and research to be included in a volume of readings will vary with the purpose of the editor and/or his publisher. Some editors lean on the criterion of "the outstanding article," others on "broad coverage," others on the "availability of important writing to potential users," others on "the representativeness" of the piece of writing selected, and so on. Professor Halcrow states that his guiding principal of selection is "to build up the broad policy—or macro-economic—phases of the subject. . . . More specialized subjects, such as the economics of irrigation, farm property taxation and crop insurance, are largely omitted."

One may question the appropriateness of the above criterion of selection (I, for one, prefer the "outstanding article" criterion tempered by "adequate coverage"). *But within the terms of his stated criterion of selection Halcrow has done a good job.* He divides the field of Agricultural Economics into seven parts—a division that will seem reasonable to most readers. Those seven parts are:

1) Development and Cumulative Change
2) Farm Production Economics
3) Agricultural Prices: Supply and Demand
4) Agricultural Marketing
5) Price-Income Policy
6) Land Economics Problems and Policies
7) Family Farm Finance and Employment

Under each of these parts Halcrow has selected a group of writings which succeed in most instances in describing the "broad policy phases" of that part. And with a few exceptions, readers will find each selection readable and informative. In other words, that mythical man from Mars

upon picking up this volume would, I believe, gain a tolerably correct impression of the limits and internal boundaries of Agricultural Economics, the more important problems confronting producers and marketers in agriculture and how Agricultural Economists go about dealing with those problems. In short, Halcrow has covered the field of Agricultural Economics as it is generally recognized.

Saying this, however, does not immobilize Cochrane the critic. There are certain aspects of this compilation that are disturbing. How Halcrow could have failed to include John Brewster's article, "Farm Technological Advance and Total Population Growth" (*JFE* Aug. 1945) under Part One: Development and Cumulative Change, is difficult to understand. If a better article dealing with development and cumulative change in agriculture has been written in recent years than the Brewster piece, I am unaware of it. The subject matter area "food consumption" is not developed under Part Four: Agricultural Marketing, or anywhere else in the volume for that matter; "food consumption" cultivated so carefully by John D. Black over the years and now worked so fruitfully by Marguerite Burk and others is wholly ignored. Finally, in the opinion of this reviewer the "Symposium on Price Policy" in Part Five, which is really a discussion of the Farm Foundation effort *Turning The Searchlight on Farm Policy,* is overdone. Without doubt the "Searchlight" piece merits inclusion, but it is questionable whether it merits a "Symposium" in light of the many other worthwhile writings on policy that had to be excluded to make way for the Symposium. Black has certainly had more important things to say on policy than that included in this volume, namely, a book review of *Turning The Searchlight on Farm Policy.*

This raises the question of how contemporary a book of *Contemporary Readings in Agricultural Economics* ought to be? In the case of Agricultural Marketing Halcrow reaches back into the 1940 yearbook of Agriculture, *Farmers in a Changing World,* for two selections, the next deepest penetration in time is 1944, but in most instances the selections carry a publication date of 1949 or later. By concentrating on writings of the past five years, Halcrow greatly reduces his selection problem, but he also eliminates some important writing, particularly in the area of price and income policy. There is, of course, no answer to this question, but a more liberal interpretation of the word contemporary might have yielded a better selection of readings in the area of price and income policy.

One cannot help but speculate on the use, or the market, for this book of readings. Most professional economists working in agriculture will want a desk copy of the volume, but unfortunately for the editor and

the publisher these users will hope to receive a copy free of charge. It may find a niche as a text in general, or survey, courses in Agricultural Economics, but more probably it will find its greatest use as a reference volume in such courses as well as other more specialized courses in Agricultural Economics. If then this book of *Contemporary Readings in Agricultural Economics* is used principally as a reference volume, it seems appropriate to look once again at the criterion used in selecting the readings included. If the above deduction as to the expected use of this volume is correct, perhaps a more appropriate criterion of selection would have been "availability of important writings to potential users." But this is something that could be debated endlessly.

The important point to bear in mind regarding this volume is, that editor Halcrow, through the device of a book of readings, has presented a broad and general view of the field of Agricultural Economics.

WILLARD W. COCHRANE

University of Minnesota

Marketing of Agricultural Products, Max E. Brunk and L. B. Darrah, New York: The Ronald Press Company, 1955. Pp. vi, 419. $5.50.

The authors state, "The purpose of this book is to give students of agricultural marketing the background necessary for them to understand and take their part in this immensely complex system." Designed as an introduction to the field of marketing, "Every attempt has been made to keep the treatment simple. Our emphasis is on the practical rather than the purely academic problems." The book is a revision of a text that has been used for several years at Cornell University.

The material covered is organized into the following five parts: (1) Introduction, (2) Factors affecting the Consumption of Farm Products, (3) Factors affecting the Supply of Farm Products, (4) Adjustment of Consumption and Supply, and (5) Marketing Agencies, Channels and Costs.

Part one includes a definition of the field of marketing, a description of the development of our marketing system, an introduction to the concept of a demand curve, and a historical account of consumption of farm products.[1] In part two, the authors discuss the relationship between food consumption and income, consumer buying habits, characteristics of various agricultural products, merchandising practices employed in the marketing of agricultural products, and particular government programs in their relation to the consumption of agricultural products. Subjects

[1] In the next to last paragraph on page 63, the income figures should be in billions rather than in millions as used throughout the paragraph.

covered in the section on the supply of farm products include a description of the current concentrations of production for particular agricultural products, and a discussion of output variation in terms of both seasonal variation and production cycles over several years. Part four has a short discussion of the role of price in adjusting production and consumption of farm products. The section then continues with a description of seasonal variation in prices of agricultural products and a general discussion of storage, grading, transportation, and methods employed in the buying and selling of farm products. The final section is devoted to a description of the various marketing agencies, flows of farm products through the marketing system, and costs of marketing.

While the general outline of the book is very promising, this reviewer felt that too much space was devoted to description of current and past patterns of consumption and production. The analysis of why these particular behavioral patterns are observed was in general too brief. In particular, there is a need for a discussion of the relationship of advertising and other selected merchandising practices as discussed in Chapter 8 to the static concept of consumers preferences guiding economic activity as outlined in Chapters 3 and 4. The welfare implications of such business behavior in a growing economy with a changing output composition are certainly different from those that would be implied by similar behavior in a static economy. For example, the welfare implications of advertising and other merchandising practices employed by firms in introducing new products represent an area of economic analysis that certainly needs more consideration than it has received in the past.

In summary, the book does provide a useful source of data concerning the marketing of agricultural products. This reviewer would like to have seen more emphasis placed on analysis of the many problems faced in the field of marketing.

CHARLES ZWICK

Harvard University

The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-1938. Volume I. By Richard Stone, assisted by D. A. Rowe and W. J. Corlett, Renee Hurstfield, Muriel Potter. New York: Cambridge University Press, 1954. Pp. xl, 435. $18.50.

This is one volume in a series of Studies in the National Income and Expenditure of the United Kingdom. If the quality and scope of the present volume is maintained in the remainder of the series, the Studies will undoubtedly command a special niche in the library of statistical economics. The present work is an impressive report of the results of

what must have been an arduous group effort under Mr. Stone's direction.

The volume consists of two parts. Part I is devoted to problems of developing basic data on consumer expenditure and its components, consumption and prices. These data are intended to form part of the complete set of a consistent series in the social accounts. Part II, The Analysis of Market Demand, develops the theoretical and empirical analysis of market demands based on the constructed series.

The presentation of basic data takes up some 220 pages. Most of these pages are devoted to food and drink, with three additional chapters on (a) tobacco, (b) rent, rates and water charges, and (c) fuel and light. Presumably such things as clothing, household supplies and equipment, automobiles and services will be considered in later volumes in the series. The descriptive chapters of Part I include sections devoted to discussion of results, methods of estimation, and reliability of the estimates; including the main tables of results, which generally consist of annual estimates of quantity, price and expenditure by commodities and commodity groups.

The detailed description of problems in obtaining, assembling and analyzing the data reminds one of the presentations in *Consumption of Food in the United States*, although Stone's descriptions are somewhat more detailed. Although similar types of problems are encountered in both publications, it is difficult to assess the relative reliability of the British and American estimates, since in each case informed judgments play an important role in attempts to reconstruct reality. Part I was sufficiently detailed to impress this reviewer with the complexities of data estimation problems, but quite inadequate to permit judging the reliability of the data or to provide a basis for quick reconstruction of estimates using alternative hypotheses. Despite this inadequacy the authors very frankly described their assumptions and guesses, where these were required in finally reaching an estimate. Their own judgments on reliability of the various series are useful adjuncts and their procedure represents a practice that American compilers of data would do well to follow more than they do.

Critical appraisal of this work will undoubtedly be focused on Part II, The Analysis of Market Demand, where the tools of the econometrician's trade are demonstrated by Stone. Although most agricultural economists are unfortunately ill equipped to handle matrix algebra, there is much of value to be read in Chapters XVII—The Problems and Objects of Econometric Analysis, XVIII—The Formulation of Market Demand Relationships, and XIX—Estimation Problems and Statistical Procedures. These chapters, together with the Introduction, will be read intensively

by budding econometricians. The statistical results, consisting of some 240 demand relationships, are presented in Chapters XX-XXII. This is followed by a chapter of Conclusions which, in some respects, raises more questions than it answers. Two appendices present supplementary data used in the analyses.

The results—after the exhausting detail of data collection and preparation and the beautifully developed chapters on theory and statistical procedure—are a decided anticlimax. The painfully collected data are all put through the same wringer of least squares using first differences of logarithms. This procedure, although still of considerable value, seems like a misallocation of resources. Most demand equations are derived through prior determination of estimates of income elasticities which are based on budget data collected at the end of the period covered in this study. Problems of multicollinearity are deemed sufficiently important that considerable effort was devoted to preparation of bunch maps. These maps are presented in the chapters of results. The usefulness of this technique has not been demonstrated and has long been open to some question. Several equations, which differ in terms of the competing or complementary commodities included in the analyses, are usually presented for each commodity. A "preferred" equation is noted which in practically all cases is the one with the highest multiple determination.

The income elasticities based on budget data (really modified expenditure elasticities) appear to be reasonable and in relative agreement with similar studies in other countries. All food is estimated as 0.53 which is not much different from American results from budget studies during the same period. Apples, canned and bottled fruit, and poultry have the highest elasticities. Each has a value in excess of 1.0. Condensed milk, fried fish and chips are negative (the latter not significant). Tea consumption seems to be quite independent of income, as is to be expected.

The price elasticity for all food of -0.35 (± 0.28) has a relatively large standard error. If drink and tobacco are omitted the elasticity is estimated at -0.58 (± 0.21). American experience suggests a similar range of uncertainty for these coefficients. Examination of the price and cross elasticities for individual commodities must raise a host of questions in the mind of any reviewer, only a small number of which could conceivably be attributed to lack of understanding of British consumers. Surprisingly, fresh milk was highly competitive with home produced beef and veal; cream was somewhat less inelastic, but highly complementary with imported eggs; cheese had a positive price elasticity and was a complement to butter; margarine demand was price independent but a strong competitor of butter, while butter was independent of

margarine; butter had cakes and biscuits as substitutes and flour as a weak complement, while margarine had cakes and biscuits as complements and chocolate and confectionery as substitutes. No flour or carcass meat relationships to the dairy products are shown except insofar as the data are included in the "all other prices" component.

Since prices are clearly endogenous, perplexing results inevitably appear when the mass of data is put through the same multiple correlation routine. Developing more suitable models for individual commodities or for small groups of commodities should yield more satisfactory and realistic results. Of course this would be more work; but, in view of the tremendous expenditure of effort in compiling the series, the models deserve at least this much respect.

One must put down this study as clearly historical since there is very little discussion or application of the results to the postwar situation. Theoretical considerations under rationing are briefly outlined but no application of them is made.

Despite these somewhat negative comments, this volume is a monument in size and content to a substantial effort. The publishers are to be congratulated on their admirable technical handling of an undoubtedly difficult assignment. The demand for reference works of this type must unfortunately be quite narrow and inelastic in view of the price ($18.50). The volume deserves a wider reading than this price may permit.

HARLOW W. HALVORSON

University of Wisconsin

NEWS NOTES

Anton H. Anderson joined the staff of the University of Nebraska, Agricultural Experiment Station on July 1, as Associate Agricultural Economist. Mr. Anderson was formerly analyst and consultant with the Royal Commission on Agriculture in rural life and was stationed at Regina, Saskatchewan.

Kenneth E. Anderson has transferred to the Market Development Branch of the Agricultural Marketing Service from the Market Organization and Costs Branch.

Lester L. Arnold, who recently completed the requirements for the Ph.D. degree in agricultural economics at Purdue University, has joined the staff of that institution as an extension specialist in the area of farm management and agricultural finance.

James Atherton, Production Economics Research Branch, Agricultural Research Service, stationed at Tulsa, Oklahoma, began a 2-year foreign assignment on May 21 with Oklahoma A. & M. College. The College is under contract with FOA to conduct an agricultural training and technical assistance program in Ethiopia. Mr. Atherton will serve in that country as a land resettlement specialist, assisting in classification of land for settlement, determining size of farm units, and type of enterprises, and advising the Ethiopian government on land policy generally.

Grant E. Blanch, Professor of Agricultural Economics at Oregon State College, is taking a two-year leave of absence to join an Oregon State College mission to Kasetsart University at Thailand. Dr. Blanch will join six other OSC staff members and will assist in the development of a farm management research and teaching program at the University. Dr. G. E. Korzan is presently serving on the Kasetsart staff in the Institute of Cooperative Sciences.

Ralph R. Botts, Production Economics Research Branch, ARS, was recently made a Fellow of the American Society for Insurance Research. He will serve on the program committee for the next annual meeting.

John C. Bower joined the staff at Montana State College on May 1, 1955 as Extension Economist. Mr. Bower was formerly with the Bureau of Reclamation.

John Bragg, formerly with the Boston Federal Reserve Bank, has been appointed Assistant Extension Professor of Marketing at the University of Massachusetts.

Imogene Bright, formerly with the Department of Labor, joined the staff of Market Organization and Costs Branch, AMS, in January, 1955.

Albert Brodell, Production Economics Research Branch, ARS, is back at work again after a period of illness that recurred following his recovery from an earlier operation.

Herbert Brown and Wade F. Gregory, Production Economics Research Branch, ARS, conducted a field survey of farm expenses and inventory of machinery on peanut-cotton farms in Georgia and Alabama during the last part of February and early March.

Max Brunk, of Cornell University, is serving as marketing research consultant to the Agricultural Experiment Station, Rio Piedras, Puerto Rico, from June 15 to September 15, 1955.

Thomas A. Burch, formerly of the University of Georgia, joined the staff of the Department of Agricultural Economics at Clemson College in May. He is doing research in the field of agricultural adjustment.

Ray Christensen, Production Economics Research Branch, ARS, has been named an assistant editor of *Agricultural Economics Research* in the interest of obtaining broader editorial coverage of the agricultural economics field. Al-

though, in the reorganization of the Department, publication of *Agricultural Economics Research* was made the responsibility of the Agricultural Marketing Service, this involved no change in scope or purpose. The journal continues to cover the whole field of agricultural economics. Its size has been increased from 32 to 40 pages. The journal is open to research workers in the Department and cooperating agencies, and to other authors on subjects relevant to research interests of the Department.

S. Kent Christensen, of Cornell University, has accepted a position with the Department of Agricultural Economics at Oregon State College as of August 1, 1955. He will do research and teaching in dairy and livestock marketing.

John R. Churchill joined the staff of the Market Organization and Costs Branch, AMS, in March 1955. He was doing research work in Haiti under a Buenos Aires Convention Fellowship before coming to AMS.

Howard Conklin, of Cornell University, is working for the FAO for five months in South and Central America this summer and fall. The remainder of his sabbatical leave will be spent at the Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.

William Cromarty has been appointed to the staff at Michigan State University. He will continue to work on developing a model of the agricultural economy to supplement the national model of the Research Seminar in Quantitative Economics at the University of Michigan.

J. A. Dawson is on leave of absence from the Economics Division, Canada Department of Agriculture for two years while working on a study at the University of Chicago on the public pricing of resources relative to grazing and irrigation in the Western United States.

Harland G. Doughty joined the staff of the Market Organization and Costs Branch, AMS, in March 1955. He was the Department of Economics and Sociology at Iowa State College.

Rollin O. Dunsdon resigned from Market Organization and Costs Branch, AMS, in March to become a member of the Department of Agricultural Economics at Purdue University as Assistant Professor in dairy marketing extension and research. Dr. Dunsdon will also assist in the work with agricultural cooperatives in Indiana.

Carl Eicher has been appointed as Marketing Specialist in the Marketing and Consumer Education program at Michigan State University.

Carson D. Evans has resigned his position as assistant agricultural economist at Clemson College to accept an appointment with the Production Credit Corporation of Columbia, South Carolina.

Loyd Fischer joined the staff of the University of Nebraska Agricultural Experiment Station on July 1, as Assistant Agricultural Economist. Mr. Fischer was research associate and graduate student at Iowa State College.

Alfred J. Fortenberry has transferred from the field office at Mesilla Park, New Mexico to the Washington, D. C. Office of Marketing Organization and Costs Branch, AMS.

J. K. Galbraith has been awarded a Guggenheim Fellowship to work on problems in economics and politics for the academic year 1955-56. He will spend the year in Switzerland. Professor Earl O. Heady of Iowa State College will teach at Harvard University during the second term of the academic year 1955-56, replacing Professor Galbraith.

Gywnn Garnett, former director of foreign trade development with the American Farm Bureau Federation, has been appointed Administrator of the Foreign Agricultural Service, USDA.

Wendell Graham has transferred from the state office at Columbia, South Carolina to the Office in Oklahoma City in the Agricultural Estimates Division of AMS.

James R. Gray, agricultural economist with the Production Economics Branch, ARS, engaged in cooperative work with the Department of Agricultural Economics, New Mexico A & M College, has been granted the first Robert Johnson fellowship at Oregon State College effective September 1, 1955. While at Oregon he will work toward a Ph.D. degree in agricultural economics. The fellowship is one of the top awards at Oregon State. Mr. Gray received a B.S. degree in range management in 1947 and a M.S. degree in agricultural economics in 1949 from Utah State Agricultural College. While at Oregon he will be on leave from his present assignment with the ARS.

Wade F. Gregory resumed his position as Associate Agricultural Economist at the Alabama Agricultural Experiment Station on January 1, 1955, after completing his course work and preliminary examinations at Chicago University. He is employed cooperatively by the Alabama Station and the USDA.

Frank Hansing, Production Economics Research Branch, ARS, has moved from Blacksburg, Virginia, to Newark, Delaware. At Newark, he will conduct a study of broiler financing in cooperation with the Delaware Agricultural Experiment Station.

Claude Haren, Production Economics Research Branch, ARS, who is back in civilian life after 3 years on military furlough, returned to duty in the Land Utilization Unit on March 14.

William Hartman, who was with the former Bureau of Agricultural Economics, is now with FOA's USA Operations Mission to Italy, stationed in Rome. He recently returned to Rome from a field study in the Belgian Congo.

H. Milton Heins resigned from the Market Organization and Costs Branch, AMS, in May to take a position with the California Wool Marketing Association in Berkeley, California.

O. C. Hester joined the staff of the Market Organization and Costs Branch, AMS, in December 1954.

Jimmye S. Hillman is Agricultural Economist for the International Cooperation Administration of the U. S. State Department, serving in Rio de Janeiro, Brazil. Dr. Hillman is on leave from the Department of Agricultural Economics, University of Arizona.

Siegfried A. Hoermann, formerly analytical Statistician with the U. S. Department of Commerce, has transferred to Farm Population and Rural Life Branch, AMS.

Eldon E. Houghton transferred in June to the Agricultural State Statistician's Office at Columbus, Ohio, Agricultural Estimates Division, AMS, from Washington, D. C.

S. C. Hudson is on leave of absence from the Economics Division, Canada Department of Agriculture while serving on a one-year assignment for the Food and Agriculture Organization in Egypt.

Verner G. Hurt has accepted a position as assistant in administration of the State Milk Audit Law with the Mississippi State Department of Agriculture and Commerce, effective June 1, 1955. Mr. Hurt received his Master of Science Degree from Mississippi State College in May, 1955, after completing graduate work in Agricultural Economics.

O. B. Jesness, Head, Department of Agricultural Economics, University of Minnesota, has been appointed as Director and Deputy Chairman of the Board of the Minneapolis Federal Reserve Bank.

Bruce W. Kelly has been appointed Agricultural Statician in the State office of the Agricultural Estimates Division, AMS, at Orlando, Florida where he has been serving as an agent.

John W. Kirkbride, has transferred from the office of the Agricultural Statistician, Agricultural Estimates Division, AMS, at Columbus, Ohio, to the Field Crops Statistics Branch, AMS, at Washington, D. C.

Rosalind Lifquist transferred from the Home Economics Research Branch, ARS, to the Market Organization and Costs Branch, AMS, in February 1955.

William G. Lodwick, former Administrator of the Foreign Agricultural Service, USDA, has been named Agricultural Attache to Mexico. He was succeeded as Administrator by Gwynn Garnett, former director of foreign trade development of the American Farm Bureau Federation.

Louis L. Madsen, in charge of beef cattle research at Beltsville, Maryland has been appointed Director, Institute of Agricultural Sciences, Washington State College, Pullman, Washington. He succeeds Dr. J. C. Knott. At Pullman, Dr. Madsen will be in charge of all teaching, research, and extension work in the field of agriculture.

Frank Maier, Production Economics Research Branch, ARS, will teach a course in land economics at the Westminster Theological Seminary in July.

Milton Manuel, Associate Professor in the Department of Agricultural Economics at Kansas State College has been granted leave for a temporary assignment with the Bureau of Census to serve as statistical consultant in the Pittsburg office for the analysis of the 1955 Agricultural Census.

Ronald Mighell, Production Economics Research Branch, ARS, is author of a new book "American Agriculture, Its Structure and Place in the Economy." This is the first volume in the new Census Monograph Series, sponsored by the Social Science Research Council and published by John Wiley and Sons, Inc. The work was done under a joint cooperative project between the United States Department of Agriculture, the Bureau of the Census, and the Social Science Research Council. Dr. Mighell has been invited to serve as a member of the Committee on Fats and Oils of the Agricultural Board of the National Research Council, of which Dr. L. J. Norton of Illinois is the chairman.

Robert S. McCauley has transferred from the office of the Agricultural Statistician, Agricultural Estimates Division, AMS, at Oklahoma, to the Field Crops Statistics Branch, AMS, at Washington, D. C.

Joe H. McLure of the Market Organization and Costs Branch, AMS, transferred from the AMS office in Atlanta, Georgia, to the Washington, D. C. office in January.

Guy W. Miller, Ohio State University, has taken two years leave to serve as Agricultural Economic Advisor with FOA, to the government of Pakistan.

Marshall E. Miller, Program Analysis Branch of the Sugar Division, Commodity Stabilization Service, transferred to the Market Development Branch of AMS. He will be stationed at New Orleans, Louisiana, where he will work on marketing research problems in cooperation with the Southern Utilization Research Branch, Agricultural Research Service.

Walter G. Miller has been appointed Cooperative Agent with the Production Economics Research Branch, ARS, and Iowa State College to work on a cooperative study on determination of the relative efficiencies of alternative tenure arrangements. Mr. Miller received his training in agricultural economics at the University of California. He has recently been taking further graduate work at Iowa State College while serving as student assistant in research on

the economics of watershed development. He will be stationed at Iowa State College.

Elmer J. Moore joined the Washington staff of Market Organization and Costs Branch, AMS, in January 1955. He formerly was in Fresno, California with the Bureau of Reclamation. He obtained an M.S. degree from the University of California in 1950 and later studied at Purdue University.

Joe E. Murphey joined the Texas Agricultural Extension Service as Extension Agent in Dairy Marketing on February 1. He received his Master of Science degree from the Texas A. & M. College in May. While completing his graduate work he served as research assistant in dairy marketing.

Ernest J. Nesius, formerly Professor of Agricultural Economics at the University of Kentucky, was appointed Associate Director of Extension at Kentucky effective February 1, 1955.

William H. Nicholls served as Technical Director of the Seventh American Assembly (Graduate School of Business, Columbia University) on "United States Agriculture: Perspectives and Prospects," which met at Arden House, Harriman, New York, on May 5-8, 1955.

J. E. O'Meara resigned from his position with the Economics Division, Canada Department of Agriculture at the beginning of June to accept a position as Education and Organization Manager with the United Co-operatives of Ontario.

Charles W. Peters resigned from the Market Organization and Costs Branch, AMS, in May 1955 to become Head of the Department of Agricultural Economics at the University of Hawaii.

Arthur G. Peterson, formerly with the Bureau of Agricultural Economics and the Office of Secretary of Defense, has transferred to the Secretariat of the Interdepartmental Committee on Nutrition for National Defense, with headquarters at the National Institute of Health, Bethesda, Maryland.

G. A. Peterson, formerly at the University of Illinois, has accepted a position as agricultural economist with the Federal Reserve Bank of Kansas City, beginning July 1, 1955.

W. H. Pine, Kansas State College, has been elected chairman of the North-Central Land Tenure Research Committee, succeeding C. L. Stewart, University of Illinois. Joseph Ackerman, Managing Director, Farm Foundation, is co-chairman. Noble Clark, University of Wisconsin, is now serving his seventeenth year as administrative adviser to the committee.

John R. Price has transferred from the Agricultural Statistician's Office of Agricultural Estimates Division, AMS, to the State Agricultural Statistician's Office at Lincoln, Nebraska.

L. H. Rhodes, Production Economics Research Branch, ARS, transferred on April 11 to the Commodity Stabilization Service. In his new assignment he will assist in carrying out the mobilization planning and civil defense planning functions of the Department.

Kenneth L. Robinson and his wife, Cornell, plan to tour northern Europe this summer and to attend the meeting of the International Association of Agricultural Economists in Helsinki.

George Rogers who was working on a temporary basis at the University of New Hampshire has accepted a position as Assistant Professor in the Department of Agricultural Economics, University of New Hampshire.

Walter B. Rogers, formerly assistant in agricultural economics with the Experiment Station of New Mexico A & M College, has been granted a gradu-

ate research assistantship at Oklahoma A & M College to work toward a Ph.D. degree in agricultural economics. He received a B.S. degree from Texas Technological College in 1951 and a M.S. degree from the University of Arizona in 1953.

Willard D. Schutz, who had been engaged in work on land classification and appraisal for tax assessment purposes at North Dakota Agricultural College, has been appointed Assistant Professor of Agricultural Economics at the University of Wyoming. Dr. Schutz was granted a Ph.D. degree from the University of Wisconsin in 1954.

Robert O. Sinclair, Assistant Agricultural Economist at the University of Vermont, has been granted a year's leave of absence for advance study at Michigan State University.

Sol Sinclair has been appointed Chairman of the newly established Department of Agricultural Economics and Farm Management at the University of Manitoba.

H. H. Stippler, Production Economics Research Branch, Agricultural Research Service, USDA, stationed at Oregon State College, will attend the International Conference of Agricultural Economists at Helsinki, Finland. He left early in June for extensive travel through European countries to observe agricultural development and conditions.

Harold L. Streetman, Assistant Agricultural Economist at Clemson College has accepted a similar position with associate rank at Auburn effective July 1.

Glenn W. Suter transferred from the Virginia State Statistician's Office of Agricultural Estimates Division, AMS, at Richmond to headquarters of Agricultural Economics Division, AMS, at Washington, D. C. to complete a unit of work at the Bureau of the Census.

Philip J. Thair joined the staff at the University of Saskatchewan at the beginning of June. He had been on the staff of the USDA at North Dakota Agricultural College for several years.

James M. Tinley is on leave from the University of California at Davis for the year 1955-56 to accept an appointment with the Food and Agriculture Organization of the United Nations. Professor Tinley's assignment deals with the working out of plans and programs for agricultural development in Yugoslavia.

Thomas E. Tramel, formerly an Assistant Professor in the Department of Agricultural Economics at Mississippi State College, has accepted an appointment as Professor of Farm Management at Virginia Polytechnic Institute, effective July 1, 1955.

Gerald Trant has been appointed to the staff at Michigan State University on assignment to the cooperative program in Colombia, South America. He leaves in July to carry on farm management work in Palmira in the Cauca Valley.

C. W. Vrooman, Assistant Professor of Agricultural Economics at Oregon State College since 1949, has resigned his position to start a Farm and Ranch Management Consultant Bureau. The new business known as C. W. Vrooman and Associates will be located at Corvallis, Oregon.

Carl Wehrwein, Production Economics Research Branch, ARS, transferred on March 27 to the Commodity Analysis Branch of the Grain and Feed Division, under Market Development, Foreign Agricultural Service.

Byron White, who received an M.A. in Economics at the University of Texas in 1954, is now Professor of Economics and Director of the Institute of Economic

Investigations at the University of Oriente, Santiago de Cuba. In March he had a book published in Havana entitled *Azucar Amargo, Un Estudio de la Economia Cubana—Bitter Sugar, A Study of the Cuban Economy.* He was formerly a Business Specialist with the Commerce Department and for many years a career Foreign Service Officer, specializing in economic reporting.

R. H. Wilcox, University of Illinois, will retire on September 1, 1955. He came to Illinois in 1915 and has been in charge of the detailed cost work at Illinois since 1928.

Alvin B. Wooten joined the Staff of the Texas Agricultural Extension Service, Department of Agricultural Economics and Sociology, as Economist, February 1, 1955. His primary responsibility is to handle education in public policy and agricultural finance. He received a Ph.D. degree by the Texas Agricultural and Mechanical College May 27, 1955, and has taught in the Economics Department of the A. & M. College of Texas and the University of Arkansas.

Norman Zellner, who has recently completed work for the Ph.D. degree at the University of California, has accepted an assistant professorship at the University of Tennessee.

Effective March 17, the title of "Solicitor" for the United States Department of Agriculture was changed to "General Counsel." His office will hereafter be known as "The Office of the General Counsel."

On April 14-16, the University of Kentucky served as host for a Seminar on Collectivization in Eastern Europe. Sixty area specialists and social scientists from all parts of the United States met to discuss and to gain an understanding of the relationship between collectivization and agricultural resource use.

A Farm Appraisal Conference was held on May 26 and 27 at the University of Illinois. Speakers included John H. Bondurant of the University of Kentucky, W. L. Calvert of the Federal Land Bank, St. Paul, and W. G. Murray of Iowa State College. Proceedings have been mimeographed.

The following new appointments have been made in the offices of the State Agricultural Statisticians under the Agricultural Estimates Division, AMS, as listed: Burton B. Barr, Fargo, North Dakota; John F. Crum, Jackson, Mississippi; Richard C. Max, Sioux Falls, South Dakota; Horace M. Mayes, Austin, Texas; Charles H. Percival, Helena, Montana; Walter L. Quincy, Sacramento, California; and Alvon D. Roark, Nashville, Tennessee.

Professors J. K. Galbraith and R. H. Holton recently completed a study launched in 1950 of marketing efficiency in Puerto Rico. This study, on which Dr. Robert Branson of Texas Agricultural and Mechanical College, Professor Carolyn Shaw Bell of Wellesley College, and Mrs. Ruth Anderson Robinson of Wells College collaborated, will be published by Harvard University Press under the title of *Marketing Efficiency in Puerto Rico.*

The Interdepartmental Committee on Nutrition for National Defense was organized in 1954, primarily to evaluate and improve the nutritional status of allied troops and civilian populations in countries where the United States has military or technical aid programs, and at the same time protect American troops serving in these countries. Dr. Frank B. Berry, Assistant Secretary of Defense (Health and Medical) is Chairman of the Committee and Dr. W. H. Sebrell, Director, National Institutes of Health, is Director of the Committee. The Secretariat consists of Dr. Harold Sandstead, M.D. (Executive Director), Dr. Arnold Schaefer, Nutritionist, and Dr. Arthur G. Peterson, Agricultural Economist. The agencies represented on the Committee are: office Secretary of Defense; Army; Navy; Air Force; State; Agriculture; Foreign Operations Administration; and Health, Education and Welfare.

NINTH INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS, OTANIEMI, FINLAND, AUGUST 19-26, 1955

Following is a list of those from the United States who expect to attend the INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS.

J. Ackerman—Farm Foundation
J. C. Bottum—Purdue
L. A. Bradford—Kentucky
James S. Brown—Kentucky
W. D. Buddemeier—Illinois
H. C. M. Case—Illinois
P. J. Findlen—Cornell
H. G. Halcrow—Connecticut
F. F. Hill—Cornell
Earl Hughes—USDA
Ralph Jennings—USDA
Glenn Johnson—Michigan
Sherman Johnson—USDA
H. J. Meenen—Arkansas
W. H. M. Morris—Purdue
W. G. Murray—Iowa
Max Myers—South Dakota
J. R. Otis—Mississippi
Don Paarlberg—USDA
Emil Rauchenstein—Wisconsin
P. M. Raup—Minnesota
K. L. Robinson—Cornell
W. J. Roth—Virginia
T. W. Schultz—Chicago
Chester Smith—New York
M. G. Smith—Ohio
H. H. Stippler—Oregon
Boris C. Swerling—Stanford
H. C. Taylor—Washington, D.C.
J. M. Tinley—California
E. C. Young—Purdue

The Conference is especially indebted to the Kellogg Foundation, the Rockefeller Foundation, the Whitney Foundation, The Council of Economic and Cultural Affairs, and a number of smaller donors who have made it possible to grant travel assistance covering a portion of the actual cost to nearly 40 delegates to the Conference from North and South America.

Theme of the Conference:

THE IMPLICATIONS OF TECHNICAL CHANGE IN AGRICULTURE

Friday, 19 August (Evening)

Addresses of Welcome
Presidential Address by Dr. L. K. Elmhirst.

Saturday, 20 August

Symposium

The Meaning of Technical Change in the Context of the Agricultural Economy of Different Environments.

(a) Scandinavia *(b)* France *(c)* S.E. Europe
(d) Asia *(e)* S. America *(f)* N. America

Sunday, 21 August

1. The Sociological and Cultural Problems Associated with Technical Changes in Agriculture.
2. The Relative Incidence on Agriculturists and on Other Groups of the Benefits resulting from Technical Change in Agriculture.

Monday, 22 August

1. Symposium
   The inter-action between Technical Change on the Farm and Technical Change in Marketing and Distribution.
   (a) Crops *(b)* Milk *(c)* Livestock
2. The Influence of Consumption Changes on the Use of Resources and on Technical Change in Agriculture.

Tuesday, 23 August

1. The Impact of Technical Change on the Employment Situation within Agriculture and on the Occupational Structure of the Population.
2. The Finance of the Additional Capital Required for Technical Change.
3. The Interdependence of Agriculture and Forestry.

Wednesday, 24 August

1. Symposium
   The Adequacy, from the Point of View of Technical Development, of contemporary Institutional Systems
   (a) Land Tenure *(b)* Layout *(c)* Settlement
2. The Impact of Technical Changes on Forest Management.

Thursday, 25 August

1. The Activities of Governmental and Other Agencies in Encouraging Technical Developments.
2. The Inter-Action between Technical Changes in Agriculture and the Pattern of International Trade.
3. The Contribution of the Agricultural Economist to Programmes of Technical Development.

Friday, 26 August

1. The Relation between the Pace of Technical Change in Farming and the Level of Agricultural Prosperity.
2. Political Obstacles tending to Retard the Increased Economic Welfare offered by Technical Change in Agriculture.

Saturday, 27 August

Departure of Tours.

Among those who have promised to take part are:

L. B. Agrait, San Juan, P.R.
O. Aresvik, Vollebekk
M. Bandini, Rome
A. G. Baptist, Ghent
J. R. Bellerby, Oxford
D. R. Bergmann, Paris
J. F. Booth, Ottawa
D. A. Bruce Marshall, Ottawa
P. V. Cardon, F.A.O.
M. Cépède, Paris
Colin Clark, Oxford
J. L. Davies, London
C. Derteano, Lima
C. von Dietze, Freiburg
J. F. Duncan, Aberdeen
E. Englund, Washington, D.C.
R. Fernandez, Mexico, D.F.
H. G. Halcrow, Connecticut
W. E. Hiley, Dartington
J. Horring, The Hague
Glenn L. Johnson, East Lansing
Sherman E. Johnson, Washington, D.C.
Arthur Jones, London
S. Krašovec, Ljubljana
E. M. H. Lloyd, London
J. J. MacGregor, Oxford
L. Malassis, Rennes
G. Medici, Rome
J. O. Morales, Turrialba
W. G. Murray, Ames
H. Niehaus, Bonn
N. A. Osara, Helsinki
Jørgen Pedersen, Århus
K. U. Pihkala, Helsinki
J. R. Raeburn, London
K. L. Robinson, Cornell
M. Rolfes, Giessen
O. Schiller, Stuttgart
T. W. Schultz, Chicago
S. R. Sen, New Delhi
K. Skovgaard, Copenhagen
A. H. Stensgard, Stockholm
T. Streyffert, Stockholm
E. C. Young, Purdue

Membership in the International Conference of Agricultural Economists is open to all agricultural economists. The membership fee is $10 for a three-year period and includes a copy of the Proceedings and such other material as the Conference may publish. Some copies of each of the last eight conferences are available for purchase. The full set of eight volumes is priced to members at $24 plus $2 postage, and $30 for non-members or libraries. The cost of individual copies ranges from $2 to $5 depending on the size of the volume and the date of the conference.

Memberships and further information may be obtained from Professor H. C. M. Case, General Secretary-Treasurer, University of Illinois, Urbana, Illinois.

AFEA WINTER MEETING IN NEW YORK
DECEMBER 27-29, 1955

In accordance with the preference of the membership (expressed in a vote during the Annual Business Meeting of August 25, 1954, at Pennsylvania State University) "to strengthen joint meetings with allied associations in the winter," the following tentative program is in preparation:

Tuesday, December 27

2:30 P.M.: "The Performance of Soviet Agriculture"
Two papers and discussion.

6:00 P.M.: Dinner Meeting
Address: "Retrospect in 1985 on Agricultural Policy of 1955"

8:30 P.M.: "Tariff Policy for the U.S.A." (jointly with the American Economic Association)
Panel and question period.

Wednesday, December 28

9:30 A.M.: "Dynamics of Food Retailing" (jointly with the American Marketing Association and the American Economic Association)
Two papers and discussion.

12:30 P.M.: Informal group luncheon to continue discussion of Food Retailing.

2:30 P.M.: "The Population Spectre—Rapidly Declining Death Rates in Densely Populated Countries" (jointly with the American Economic Association)
Papers and discussion.

8:30 P.M.: Address by the President of the American Economic Association; AFEA members are invited to attend.

Thursday, December 29

9:30 A.M.: "The Land Tenure Situation Around the World" (jointly with the American Economic Association)
Papers and question period.

12:30 P.M.: Informal group luncheon to continue discussion of Land Tenure.

2:30 P.M.: "Minimum Wages and Other Labor Standards, Considered in Relation to Economic Growth in Underdeveloped Countries" (jointly with the American Economic Association)
Papers and question period.

6:00 P.M.: Executive Committee Dinner Meeting

NOTE: There may be two or three more joint sessions with other associations.

KARL BRANDT, *President-Elect*